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The Carabid Beetles of New Guinea Part III. Harpalinae (Continued): Perigonini to Pseudomorphini

P. J. DARLINGTON, JR.

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THE CARABID BEETLES OF NEW GUINEA PART III. HARPALINAE (CONTINUED): PERIGONINI TO PSEUDOMORPHINI

P. J. DARLINGTON, JR.[1]

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[1] Work supported by National Science Foundation Grant GB-93; see also p. 2.

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INTRODUCTION TO PART III

Purpose; other parts; acknowledgments. This is the third part of a taxonomic survey of the beetles of the family Carabidae (predaceous ground beetles) of the island of New Guinea.[2] The present part covers the tribes of the subfamily Harpalinae from Perigonini through Pseudomorphini, and thus completes coverage of the family Carabidae in the approximate order of the Junk-Schenkling Catalogue (Csiki 1932–1933). Part IV, which is now being prepared, will be primarily a summary, analysis, and discussion of the New Guinean carabid fauna as a whole. Among subjects to be considered are the general nature of the fauna, its geographic relationships and origins, its ecologic composition, and its evolution including specific evolutionary trends (toward wing atrophy, etc.) and evolutionary radiations on New Guinea. However, Part IV will include also a taxonomic supplement to list important new records of previously recorded species and to describe a number of additional species received recently, especially new Agonini from high altitudes.

I have already acknowledged, in Parts I and II, aid received from the Guggenheim Foundation. I have now to acknowledge also aid received from the National Science Foundation (Grant GB-93), which has supported my work on Carabidae of New Guinea in many ways, including publication of the results.

For meticulous editing and typing of the manuscript of Part III, I am indebted to Mrs. Judith Koivumaki, and for the accurate outline drawings and realistic watercolors, to Mrs. Mary Catron.

Sources and disposition of material. Principal initial sources of material used in my work on New Guinean Carabidae have been acknowledged in Part I, page 323, and Part II, pages 90–91. However, notable additional material has been received recently. Most important are thousands of specimens collected for the Bishop Museum by several entomologists under the direction of Dr. J. L. Gressitt; Mr. Josef Sedlacek and his wife and son have obtained an especially large number of Carabidae for the Bishop Museum. An important collection has been submitted for study also by the Department of Agriculture, Port Moresby, through the kindness of Mr. J. J. H. Szent-Ivany; this collection includes much material from the Port Moresby area, and also specimens from other localities including some from high altitudes. Sent with this collection, but belonging to him personally, is a fine lot of Carabidae collected by Dr. R. W.

[2] Part I, covering the Cicindelinae, Carabinae, and Harpalinae through Pterostichini (in the order of the Junk-Schenkling Catalogue) and Part II, covering the Agonini, are in the Bulletin of the Museum of Comparative Zoology: Part I, in Vol. 126, No. 3, 1962, pp. 321–564, 4 plates; and Part II, in Vol. 107, No. 3, 1952, pp. 87–252, 4 plates. (Because of my special interest in the Agonini, Part II was written and published before Part I.)

Hornabrook; this too includes material from high altitudes. A collection submitted by the Australian Commonwealth Scientific and Industrial Research Organization, at Canberra, includes specimens from the Morehead River, on the south coast of Papua almost opposite the tip of Cape York; several Australian species not known elsewhere in New Guinea were found at this locality. And an interesting collection has been submitted by the South Australian Museum, including much material from Mt. Lamington, Papua.

Because different collections have been received at different times, and because different portions of my manuscript have been finished at different times, I have not set a single deadline for material included in the present part of my work. I have simply used in each case the specimens available when a given group was studied, with only a few especially important additional records interpolated later. Additional noteworthy records will be included in the supplement in Part IV, referred to above.

Several of the most productive New Guinean carabid collectors, whose names appear many times in the following pages, are associated with single museums. In order to save space, I shall cite these collectors without repeating the names of their museums. The persons in question, and the museums with which they are associated and to which their specimens belong, are:

(Ludwig) Biró: Hungarian National Museum, Budapest

(Miss L. Evelyn) Cheesman: British Museum

(P. J.) Darlington (Jr.): Museum of Comparative Zoology, Cambridge, Massachusetts, abbreviated M.C.Z.

(J. L.) Gressitt: Bishop Museum, Honolulu

Sedlacek(s): Bishop Museum, Honolulu (Citation of this name in the singular indicates Mr. Josef Sedlacek; in the plural, additional or different members of the Sedlacek family: Marie and/or J. H. Sedlacek)

(L. J.) Toxopeus: Leiden Museum

Other museums and collections of which the names are abbreviated are:

American Museum of Natural History (New York): A.M.N.H.

California Academy of Sciences, San Francisco: Cal. Acad.

Commonwealth Scientific and Industrial Research Organization, Canberra, Australia: C.S.I.R.O.

United States National Museum, Washington, D. C.: U.S.N.M.

Policies and methods; type examinations; measurements; drawings. My work is second-stage taxonomy (see Part I, pp. 328–330). My methods have been described in Part I, page 330, and Part II, pages 91ff. However, I should repeat and stress certain things. I have tried to be reasonably consistent in preparing descriptions but have not followed a single model exactly. I have treated some tribes and some genera in much more detail than others, the rule being to give the information that has seemed worth giving in each case. My descriptions do follow a basic form but are flexible in detail. I do not like check-list taxonomy, in which descriptions are (in effect) drawn by inserting adjectives in blank spaces in a standard form. This kind of taxonomy is easy, but it is likely to be poor taxonomy. I think it is better to describe each species individually, following of course some sort of basic pattern, and if I state under one species that a character is striking, I see no reason to state (say) twenty times under other species that it is not striking.

Although the present part is consistent with Parts I and II in general, I have made a few slight changes of usage to conform to two publications that have appeared recently. One is the "Style Manual for Biological Journals," published in 1960 by the American Institute of Biological Sciences, 2000 P St., NW, Washington, D. C., 20016. The other is the revised edition (1964) of the International Code of Zoological Nomenclature. I have in general adopted

the details of style suggested by the former, and have tried to follow the rules and most recommendations of the latter. However, although I have followed the Style Manual in most ways including most abbreviations, I have occasionally preferred to follow Webster's Collegiate Dictionary on points of general style where I see no reason why biologists should be different.

References listed under tribes, genera, and species are limited to items directly concerned with New Guinea plus selected items likely to be specially useful to workers on New Guinean Carabidae.

Type examinations. In the present part of my work I have indicated what types of previously described species have been seen and not seen. I have borrowed for study a few types in especially difficult genera in which my work has been in effect revisionary (in *Perigona*, for example), but I have not attempted to see or to borrow types in most cases. There are two reasons for this. First, I do not think types should be loaned merely to confirm identifications in faunal work, especially when the types come from outside the area under study, in the present case often from other islands or from Australia rather than from New Guinea. And second, H. E. Andrewes saw many of the types in question and made comparisons with them (see my Part I, p. 325), and my study of the Andrewes Collection has enabled me to place not only his own but also most of the older Oriental species with reasonable confidence. I do, however, plan to see many of the older types, including those in Paris, before completing Part IV, so that I should be able to correct errors of identification then.

Measurements. Statements of proportions have been calculated (with a slide rule) from actual measurements made with a ruled disc in the ocular of a stereoscopic microscope. Proportions *cannot* be estimated satisfactorily by eye. When possible, the proportions are based on measurements of an average-looking ♂ ♀. The specimens thus measured are usually specified in a paragraph headed *Measured specimens*, but this paragraph is omitted under species of which only one or two individuals are known. Measurements of length and width are extremes of all available specimens.

Drawings. My drawings are designed primarily to show gross form, which is very difficult to describe in words. Mouthparts, antennae, and legs are sketched in semi-diagrammatically. The drawings have been outlined by Mrs. Mary Catron (usually with use of a crosslined disc in the ocular of a stereoscopic microscope), checked by me (the checking including measuring and calculating of proportions), and then inked by Mrs. Catron. I have not tried to figure all species or even all new ones, but have tried to show unusual ones and also new species that are based on only one or two specimens. I expect to deposit representative sets of specimens in museums in London, Honolulu, Canberra, and elsewhere, as well as in the continental United States, and persons working on New Guinean Carabidae in the future should use my specimens rather than figures of them which (like all figures) are sure to be inadequate. I have usually not used and therefore not illustrated genitallic characters. I expect to discuss this matter—when and how to use genitallic characters in carabid taxonomy—in Part IV.

Localities. I plan to include in Part IV a map showing, as far as possible, all localities at which Carabidae have been obtained in New Guinea. In the meantime the preliminary map published in Part II, page 93, shows my own localities, most of Miss Cheesman's, and some others, and the sketch map in Part I, page 326 shows the route of my collecting on the Bismarck Range. Also, the Bishop Museum has issued a 19-page "List of New Guinea Localities" (to 1966) which gives approximate latitudes, longitudes, and altitudes of the localities of Bishop Museum collectors and of some other persons. This list is, I suppose, available on request. I have used it as a standard for spelling of place names.

Certain localities have become especially important in the course of my work. Dobodura, Papua, where I collected from March to July 1944 (see Part I, pp. 325–326), is by far the best known *lowland* locality in New Guinea, for Carabidae. Wau, in the Morobe District, N-E. N. G., is by far the best known *middle-altitude* locality, thanks principally to the efforts of the Sedlaceks. And Mt. Wilhelm on the Bismarck Range, N-E. N. G. (where I collected), and the Snow Mts., West N. G. (where Toxopeus collected during the Netherlands Indian-American (Third Archbold) Expedition of 1938–1939), are the only *very-high-altitude* localities well known for Carabidae. Comprehensive collections from other localities, especially at high altitudes, are much needed to show at what intervals localized species replace each other on New Guinea. Until this is known, the total number of species of Carabidae on the island cannot even be guessed at closely.

Additional evidence that the label "Dor(e)y" has been wrongly placed on many of Wallace's Carabidae that probably really came from Celebes or the Moluccas is given in the present part of my work: see, for example, under *Amblystomus* (p. 20). For general discussion of this locality see Part I, pages 330–331. Although many specimens so labeled evidently did not come from Dorey, Wallace did go there. Some of his field notes from there are quoted under *Catascopus* in the present part of my work (p. 102).

Findings. Although analysis and discussion of the New Guinean carabid fauna as a whole will be postponed to Part IV, a few special points are worth noting now.

Several genera that are chiefly Australian have been found at high altitudes on New Guinea, Java, and sometimes other islands in the Malay Archipelago. These genera include *Mecyclothorax* (Part I, pp. 498, 505); *Microferonia* (present part, p. 18); and *Scopodes* (present part, p. 197). One genus, *Chydaeus* (p. 47), has been found with an opposite pattern of occurrence, on the mainland of Asia and at high altitudes on mountains in the Malay Archipelago east to New Guinea. However, *Bembidion* and *Trechus* have *not* been found on mountains in New Guinea, although Asiatic stocks of these genera have reached high mountains farther west in the Malay Archipelago (Darlington, 1959, *Pacific Insects*, Vol. 1, pp. 331–345).

Important evolutionary patterns, of notable radiations of Carabidae on New Guinea, have been found in the Agonini (Part I) and are described and discussed for several genera treated in the following pages. The most striking, in fact exciting, case is in the lebiine genus *Demetrida*, which seems to be in the midst of an evolutionary explosion. The situation among these diversely colored carabid beetles in the mountain rain forests of New Guinea parallels in some ways the situation among the birds of paradise in the same forests. I have seen about 1250 specimens of *Demetrida* from New Guinea, representing apparently 56 species, all new! See discussion under the genus (pp. 142–143) for further details. Less striking, but nevertheless important, radiations of species chiefly within the confines of New Guinea are described in *Trichotichnus* (pp. 48–59), *Catascopus* (pp. 101–110), *Dolichoctis* (pp. 124–132), *Anomotarus* (pp. 186–191), *Scopodes* (pp. 197–202), *Dicraspeda* (pp. 210–214), and *Helluonidius* (pp. 229–232).

TAXONOMIC SECTION

Tribe PERIGONINI

Platynini group *Perigonae* G. H. Horn 1881, Trans. American Ent. Soc. 9, p. 143.

Perigonini Csiki 1931, Coleop. Cat., Carabidae, Harpalinae 5, p. 894 (see for synonymy and additional references).

Jedlicka 1964, Reichenbachia 2, No. 61, pp. 267–274 (Oriental forms).

Perigonitae Jeannel 1941, Rev. française d'Ent. 8, p. 137.

Perigonidae Jeannel 1948, Coléop. Carabiques de la Région Malgache, Part 2, p. 733.

The taxonomic limits of this tribe and its

relation to other tribes of Carabidae are doubtful but need not be discussed here. The only genus of the tribe in New Guinea is *Perigona* itself (*sensu lato*).

Genus *PERIGONA* Castelnau

Castelnau 1835, Étude Ent., p. 151.
Sloane 1903, Proc. Linn. Soc. New South Wales 28, p. 635.
Andrewes 1929, Tijdschrift voor Ent. 72, p. 326 (Sumatran species).
Csiki 1931, Coleop. Cat., Carabidae, Harpalinae 5, p. 895 (see for synonymy and additional references).
Jedlicka 1935, Neue Carabiden aus Ostasien, Part 10, pp. 17–19 (Philippine species).
——— 1964, Reichenbachia 2, No. 61, pp. 267–274 (Oriental species).
Jeannel, see references under tribe, above.
Euryperigona Jeannel 1941, Rev. française d'Ent. 8, pp. 138, 149 (new synonymy).
Subgenus *Trechicus* Leconte 1853, Trans. American Philosophical Soc. 10, p. 386.

Diagnosis. Small *Tachys*- or *Trechus*-like Carabidae; with usually 2 setae over each eye; apical segments of palpi rather long, usually subconical; other technical characters given by Jeannel.

Description. None needed here, except note that all known New Guinean species are fully winged.

Type species. Of *Perigona*, *P. pallida* Castelnau of Africa; of *Euryperigona*, *P. procera* Fauvel of Java; of *Trechicus*, *T. umbripennis* Leconte (= *Perigona nigriceps*, below).

Generic distribution. **World-wide** in tropical and warm temperate regions. See also 4th paragraph of following *Notes*.

Notes. Euryperigona Jeannel is based on *Perigona procera* Fauvel, a very large species with maxillary palpi long, slender, with penultimate segments relatively long. *Perigona rex* (below) would go in *Euryperigona*, if this genus were recognized. However, "*Euryperigona*" *nitida* Jeannel 1941 (= *Perigona grandis* Jedlicka 1935) of the Philippines has maxillary palpi relatively shorter and with penultimate segments shorter than in *procera*, and tends to connect the latter with more typical *Perigona*, and I do not think generic separation is advisable.

Jeannel divides *Perigona* into 2 subgenera which seem natural and useful. They differ in arrangement of submarginal elytral punctures and they differ also in habits: *Perigona sensu stricto* occurs (in my experience) only or mostly on or in logs or rotting wood; subgenus *Trechicus*, among dead leaves or debris on the ground, usually in forest. *Perigona (Trechicus) nigriceps* (Dejean) has extended its ecological range to include fermenting vegetation and various plant materials carried by man, and has been spread over all the warmer parts of the world.

Variation of supraocular and lateral prothoracic setae in this genus is noteworthy. In *rex* (below) all these setae are absent. In *P. lata* Andrewes of Sumatra the anterior supraocular and median-lateral prothoracic setae are absent in both type and "cotype" in the British Museum. And in *P. astrolabica* Csiki the posterior-lateral prothoracic setae are present or absent, as described under this species below.

Species of *Perigona* are numerous in tropical Asia and the Malay Archipelago. Fourteen occur in New Guinea. However, only 5 (*nigriceps* and 4 endemic species) occur in Australia (Darlington, 1964, Psyche 71, pp. 125–129). The New Guinean *Perigona* fauna is therefore Oriental in general nature and diversity, and it is Oriental also in relationships of most species, so far as relationships can be determined.

Earlier keys to species of *Perigona* of the Malay Archipelago (Andrewes 1929; Jedlicka 1935, 1964) and Australia (Sloane 1903) have been based principally on size and color, but most of the 14 New Guinean species have diagnostic structural characters, as the following *Key* shows. I am indebted to Dr. Z. Kaszab for an opportunity to examine the types of Csiki's New Guinean species.

The following species recorded from New Guinea are still unknown to me, and are not included in the *Key*.

SPECIES OF *PERIGONA* PREVIOUSLY RECORDED FROM NEW GUINEA BUT NOT RECOGNIZED FROM DESCRIPTION

Perigona litura (Perroud & Montrousier)

Perroud & Montrousier 1864, Ann. Soc. Linnéenne Lyon 11, p. 72 (*Trechus*).
Andrewes 1929, Tijdschrift voor Ent. 72, p. 372 (in key).
——— 1933, Tijdschrift voor Ent. 76, p. 363.
Csiki 1931, Coleop. Cat., Carabidae, Harpalinae 5, p. 897 (see for additional references).

This species was described from **New Caledonia**. It is listed by Csiki from several islands in the Malay Archipelago, including **New Guinea**, but I cannot find the source of the New Guinean record. Andrewes did not know the species. Details given in the original description, and the fact that the type(s) occurred in detritus, suggest that it may be a color form of *nigriceps*.

Perigona subcordata Putzeys

Putzeys 1875, Ann. Mus. Civ. Genoa 7, p. 730.

This species was described from the **Kei Islands** and is likely to occur in New Guinea. The size and other details suggest that it may be an earlier name for *astrolabica* Csiki.

Perigona suturalis Putzeys

Putzeys 1875, Ann. Mus. Civ. Genoa 7, p. 728.

The type was collected at Sorong, **West New Guinea**, by Beccari and D'Albertis, and is now in the Genoa Museum. Putzeys' description does not permit an exact determination but suggests a small specimen of *astrolabica* Csiki or a large one of *subcyanescens* Putzeys.

KEY TO SPECIES OF *PERIGONA* OF NEW GUINEA

1. Group of 3 punctures in outer submarginal channel of elytron (at 3/5 or 2/3 of elytral length) forming a straight line (*Perigona sensu stricto*) 2
– These 3 punctures forming a triangle (subgenus *Trechicus*) 9
2. Supraocular and lateral prothoracic setae absent; very large (9.4–12.4 mm) (p. 8) ..... *rex*
– Two pairs supraocular and usually 2 pairs lateral prothoracic setae present; size smaller 3
3. Frontal foveae weak, subobsolete; elytra each with 2 dorsal punctures, no subapical puncture above marginal channel; length *c.* 2.0–2.5 mm (p. 8) ..... *pygmaea*
– Frontal foveae short but distinct, margined externally by weak elevations; elytra with 3 punctures, the 3rd either posteriorly on disc or subapically above marginal channel; usually larger 4
4. Elytra with 3rd (posterior) dorsal puncture on disc, separated from marginal channel by more than width of latter; *if* in doubt, refer here specimens over 4 mm long 5
– Elytra with 3rd puncture farther back, just above edge of marginal channel 7
5. Posterior dorsal elytral punctures less than 1/10 of elytral length from apex; length *c.* 4–6 mm (p. 9) ..... *astrolabica*
– Posterior dorsal elytral punctures more than 1/10 of elytral length from apex; usually smaller 6
6. Form normal, moderately broad and depressed; length *c.* 3.3–4.0 mm (p. 9) ..... *subcyanescens*
– Form narrower, subcylindrical; length 2.6–3.7 mm (p. 10) ..... *papuana*
7. Larger, *c.* 4.5 mm; dark castaneous with reddish suture and appendages (p. 10) ..... *rossi*
– Smaller; *if* approaching *rossi* in size, form more depressed and color testaceous 8
8. Depressed; nearly uniform testaceous with head browner but elytra not plagiate; length slightly over 3 mm (p. 10) ..... *livens*
– Less depressed; partly testaceous but with head and much of elytral discs darker; length under 3 mm (p. 11) ..... *plagiata*
9. Submarginal channel of elytra behind puncture-triangle (at 2/3 or 3/5 of elytral length) wide, with bottom flat or convex 10
– Submarginal channel behind puncture-triangle very narrow 12
10. Color *either* testaceous with dark head and elytral apices *or* brownish castaneous with head slightly darker and suture paler; eyes large, forming *c.* right angles with neck; front and neck with distinct *c. isodiametric* reticulation (p. 11) ..... *nigriceps*
– Color dark castaneous with suture not or not much paler; eyes variable; microreticulation of head often less distinct, often (not always) transverse posteriorly 11
11. Eyes larger; microsculpture of posterior part of head (if visible) not obviously transverse; length usually *c.* 3.2–3.6 mm (rarely smaller) (p. 12) ..... *erimae*
– Eyes smaller and less prominent; microsculpture of posterior part of head (if

visible) more transverse; length *c.* 2.7–3.3 mm (rarely larger) (p. 12) *ludovici*

12. Prothorax with sides not strongly sinuate and posterior angles not denticulate; length *c.* 2.8–3.3 mm (p. 13) *lebioides*
– Sides of prothorax strongly sinuate *or* posterior angles denticulate 13
13. Sides of prothorax strongly sinuate about ⅛ of length before base; (fine) microsculpture present; length *c.* 3.4 mm (p. 13) *cordens*
– Sides of prothorax nearly straight and converging posteriorly, but posterior angles abruptly prominently denticulate; microsculpture absent or nearly so; length *c.* 3.2–3.4 mm (p. 14) *dentifer*

Perigona (*s.s.*) *rex* n. sp.

Description. With characters of genus; form as in Figure 1; very large, broad, depressed; brownish castaneous, lower surface and legs more reddish; rather shining, reticulate microsculpture fine, lightly impressed, *c.* isodiametric on head, slightly transverse on pronotum and elytra. *Head* 0.58 and 0.60 width prothorax; mandibles shorter and more curved than usual in genus; eyes rather small but prominent, enclosed behind by genae; antennae with middle segments *c.* 1½ × long as wide; maxillary palpi slightly shorter than in *P. procera* Fauvel, with apical segments slightly more conical, and with subapical segments *c.* equal length of apical ones; frontal impressions vague; supraocular setae absent; mentum with a long, triangular tooth. *Prothorax*: width/length 1.64 and 1.56; base/apex *c.* 1.33 and 1.22 (exact measurements impossible because basal angles broadly rounded); lateral setae absent; disc with fine middle line, other impressions vague. *Elytra*: width elytra/prothorax 1.20 and 1.24; striae absent or faintly indicated; each elytron with 2 to 4 dorsal punctures (variation individual, sometimes unsymmetric), anterior puncture farther than others from suture. *Secondary sexual characters*: ♂ front tarsi scarcely dilated but usually with inconspicuous 2-seriate squamae on first 3 segments below (only near apex of 1st segment, and sometimes missing, perhaps broken off); ♂ with posterior femora dentate on upper posterior side near apex; ♂ with usually 3, ♀ 4 or 5 seta-bearing punctures each side last ventral segment. *Measurements*: length 9.4–12.4; width 3.8–5.0 mm.

Types. Holotype ♂ (Bishop Mus.) and 1 ♀ paratype (M.C.Z., Type No. 31,344) from Sepalakembang, Salawaket Rge., **N-E. N. G.,** 1920 m, holotype Sept. 11–14 and paratype Sept. 15, 1956 (E. J. Ford, Jr.); and the following additional paratypes. **N-E. N. G.**: 2, Wau, Morobe Dist., 1400 m, Mar. 29, 1963 (Sedlaceks); 1, same locality, 1650 m, Feb. 23, 1962 (Sedlaceks); 1 ♂, Feramin, 1200–1500 m, May 23–31, 1959 (W. W. Brandt, Bishop Mus.). 1 ♂, Okapa (Busa), [1650–1800 m], Oct. 17, 1964 (Hornabrook); 1 ♂, Morae, Kukukuku [Rge.], E. Highlands, 6000 ft. (*c.* 1850 m), Mar. 1, 1964 (Hornabrook). **West N. G.**: 1 ♂, Mt. Cyclops, 3500 ft. (1067 m), Mar. 1936 (Cheesman).

Measured specimens. The ♂ holotype and ♀ paratype from Sepalakembang.

Notes. This remarkable species would go in *Euryperigona* if the latter were recognized (see discussion under genus). So far as I know it is unique in *Perigona* in loss of all supraocular and lateral prothoracic setae and in the toothed posterior ♂ femora. It is comparable to *P. procera* Fauvel of Java in size but is broader, and *procera* has the above-mentioned setae and does not have toothed ♂ femora.

Perigona (*s.s.*) *pygmaea* Andrewes

Andrewes 1930, Treubia, Supplement 7, pp. 334, 345.

Description (for recognition only). A very small *Perigona* characterized by weak frontal sulci and absence of 3rd (subapical) elytral punctures; length *c.* 2.0–2.5 mm.

Type. From **Buru**, collected by Toxopeus; now in British Mus. (seen).

Occurrence in New Guinea. **Papua**: 4, Dobodura, Mar.–July 1944 (Darlington). **N-E. N. G.**: 2, lower Busu R., Huon Pen., May 12 and 17, 1955 (E. O. Wilson, M.C.Z.,

1 specimen numbered 1056); 20, Sattelberg, 1899 (Biró); 3, Stephansort, Astrolabe Bay, 1898, 1900 (Biró); 5, Aitape, Aug. 1944 (Darlington). **West N. G.**: 12, Maffin Bay, Aug. 1944 (Darlington).

Notes. I have this species also from Leyte and Luzon in the **Philippines**, and have examined Andrewes' type from **Buru**. My Dobodura specimens were taken under bark of rotting logs in rain forest.

Of all New Guinean *Perigona*, this seemed most likely to include short-winged individuals, but I have examined all specimens listed above, and all are in fact long-winged.

Perigona (*s.s.*) *astrolabica* Csiki

Csiki 1924, Ann. Mus. National Hungary 21, p. 172.

Description. None required here; size, and number and position of dorsal elytral punctures are diagnostic, in New Guinea; length 4.3–6.0 mm except only 3.8 mm in an apparent dwarf of this species from Dobodura.

Type(s). From Stephansort, Astrolabe Bay, **N-E. N. G.,** collected by Biró in 1898; in Hungarian National Mus. (seen).

Occurrence in New Guinea. **Papua**: 13, Dobodura, Mar.–July 1944 (Darlington); 1, Kokoda, 1200 ft. (366 m), June 1933 (Cheesman). **N-E. N. G.**: holotype + 2, Stephansort, Astrolabe Bay, 1897 (Biró); 1, Sattelberg, 1899 (Biró); 1, Finschhafen, Huon Pen., 150 m, Apr. 14, 1964 (Sedlacek); 6, Saidor, Gabumi Village, Finisterre Rge., June 24–30, July 1–21, 1958 (W. W. Brandt, Bishop Mus.); 1, Wum, Upper Jimmi Vy., 840 m, July 18, 1955 (Gressitt); 1, Wau, Morobe Dist., 1150 m, Nov. 7, 1961 (Sedlaceks); 1, same locality, 1450 m, Feb. 5, 1963 (Sedlacek); 1, same locality, 1700 m, Feb. 19, 1963 (Sedlacek); 1, Bulolo, "G. Pines," 600 m, Feb. 19, 1962 (Sedlacek). **West N. G.**: 1, Hollandia, July–Sept. 1944 (Darlington); 1, same locality, May 1945 (B. Malkin, U.S.N.M.); 1, Ifar, Cyclops Mts., 450–500 m, Sept. 9, 1962 (Sedlacek); 1, Maffin Bay, July 8, 1944 (E. S. Ross, California Acad.); 4, Rattan Camp, 1150 m, Feb.–Mar. 1939 (Toxopeus).

Notes. P. astrolabica seems close to but probably distinct from *jacobsoni* Andrewes of Sumatra, in which the suture is red (usually not red in *astrolabica*) and the microreticulation of pronotum and elytra more transverse. Two more, perhaps related, apparently undescribed species occur in Luzon.

All specimens seen from New Guinea have all usual supraocular and prothoracic setae (or punctures marking positions of setae) except that the 4 from Rattan Camp and the 1 from 1700 m at Wau lack posterior-lateral prothoracic setae. However, presence or absence of these setae is apparently simple dimorphism, for of 6 specimens from Cape Gloucester, New Britain (Darlington), 5 lack and 1 has posterior-lateral setae. Because the distribution of individuals with and without posterior-lateral prothoracic setae may be of interest in the future, I have listed (above) all New Guinean specimens of the species in detail rather than summarizing the species' occurrence.

Perigona (*s.s.*) *subcyanescens* Putzeys

Putzeys 1875, Ann. Mus. Civ. Genoa 7, p. 732.
Csiki 1924, Ann. Mus. National Hungary 21, p. 172.
Andrewes 1930, Treubia, Supplement 7, p. 334.
Louwerens 1953, Verhandlungen Naturforschenden Gesellschaft Basel 64, p. 305.
horni Jedlicka 1935, Neue Carabiden aus Ostasien, Part 10, pp. 18–19 (new synonymy).

Description. None required here. See preceding *Key to Species* for identification; length (in New Guinea) *c.* 3.3–4.0 mm.

Types. Of *subcyanescens*, from Andai, near Dorey, **West N. G.,** collected by Beccari and D'Albertis, in Genoa Museum. Of *horni*, from Imungan, **Luzon**, in Jedlicka's collection. (See 2nd paragraph of following *Notes.*)

Occurrence in New Guinea. Widely distributed and common on the island: 48 specimens from 13 localities scattered from Milne Bay to Sansapor, and including Dobodura and Wau (to 1100 m).

Notes. Outside **New Guinea**, this species is recorded from West **Sumba** (Louwerens); **Borneo**; Mindanao, Samar, and Luzon in the **Philippines**; and doubtfully from **Buru** (Andrewes); and I have seen specimens from **New Britain** and the **Solomons**.

My identification of *subcyanescens* is based on specimens borrowed from the Genoa Museum, one marked as compared with Putzeys' type presumably by Csiki, and my identification of *horni* is based on comparison with Philippine "cotypes" in the British Museum.

Perigona (*s.s.*) *papuana* Csiki

Csiki 1924, Ann. Mus. National Hungary 21, p. 173.

Description. None required here. See *Key to Species*, and note subparallel cylindrical form; length 2.6–3.7 mm.

Types. Lectotype (by present designation) and paratype from Stephansort, Astrolabe Bay, **N-E. N. G.,** 1898 (Biró); in Hungarian National Mus. The specimen (sex not determined) now designated lectotype bears the original "Holotypus" label, although no holotype was specified.

Occurrence in New Guinea. **N-E. N. G.**: 4 (in addition to the types), Stephansort, 1898 (Biró); 1, lower Busu R., Huon Pen. May 17, 1955 (E. O. Wilson #1066, M.C.Z.), in lowland rain forest; 1, Wau, 1300 m, July 27 (year and collector not given).

Notes. This distinct species seems to be confined to a limited area on the north side of N-E. New Guinea.

Perigona (*s.s.*) *rossi* n. sp.

Description. With characters of genus; form as in Figure 2, *c.* as in *astrolabica* but slightly more slender and convex; dark castaneous, suture reddish, appendages reddish testaceous; rather shining, reticulate microsculpture isodiametric on head, in part transverse on pronotum, more transverse on elytra. *Head* 0.70 width prothorax; mandibles pointed and slightly curved but not notably elongate; eyes moderate, narrowly enclosed behind by genae; antennae moniliform; palpi with apical segment much longer than subapical, narrowed and almost pointed apically; frontal impressions short, shallow, diverging posteriorly; 2 setae over each eye. *Prothorax*: width/length 1.43; base/apex 0.90; apex broadly emarginate, with angles well defined but not advanced beyond arc of emargination; base emarginate-truncate, with basal angles distinct but obtuse, slightly blunted; sides broadly rounded, each with usual 2 setae; disc with middle line distinct, baso-lateral impressions weak. *Elytra*: width elytra/prothorax 1.25; humeri rounded-prominent; apices broadly but irregularly rounded to obtuse but well defined sutural angles; striae vaguely indicated; intervals punctulate, 3rd with punctures at *c.* ⅓ and ⅔ of length and at apex just above submarginal channel. *Secondary sexual characters*: ♂ unknown; ♀ with several setae each side apex last ventral segment. *Measurements*: length *c.* 4.5; width 1.7 mm.

Type. Holotype ♀ (California Acad.) from Maffin Bay, **West N. G.,** June 1944 (E. S. Ross); the type is unique.

Notes. This species resembles *astrolabica* but differs in details of shape especially of prothorax, and in position (nearer apex) of posterior elytral punctures.

Perigona (*s.s.*) *livens* Putzeys

Putzeys 1873, Ann. Mus. Civ. Genoa 4, p. 225.
Andrewes 1926, Cat. Philippine Carabidae, p. 354.
——— 1930, Cat. Indian Insects, Part 18, Carabidae, p. 265.
Jedlicka 1964, Reichenbachia 2, No. 61, pp. 268, 270.

Description (for recognition only). A depressed, pale *Perigona s.s.* with technical characters indicated in the preceding *Key to Species*; length (in New Guinea) *c.* 3.3 mm.

Type. Doubtfully from Coromandel, **India**; via Chaudoir and then Oberthür Colls. to Paris Mus. (not seen).

Occurrence in New Guinea. **Papua**: 2, Dobodura, Mar.–July 1944 (Darlington).

Notes. P. livens is listed by Andrewes

(1926) from Luzon and Mindanao in the **Philippines**, and Andrewes (1930) indicates that he saw Putzeys' type. I have a Philippine (SE. Bataan) specimen identified as *livens* by comparison with Andrewes' collection. The New Guinean specimens do not match Philippine ones exactly, but my material is too limited to justify separating the New Guinean form even as a subspecies.

Perigona (*s.s.*) *plagiata* Putzeys

Putzeys 1875, Ann. Mus. Civ. Genoa 7, p. 734.
Andrewes 1930, Cat. Indian Insects, Part 18, Carabidae, p. 266.
Csiki 1924, Ann. Mus. National Hungary 21, p. 172.
——— 1931, Coleop. Cat., Carabidae, Harpalinae 5, p. 898 (see for additional synonymy and references).
Jedlicka 1935, Neue Carabiden aus Ostasien, Part 10, p. 18 (in key).
——— 1964, Reichenbachia 2, No. 61, pp. 268, 271.
Van Emden 1937, Stettiner Ent. Zeitung 98, p. 35.
annamita Fauvel 1907, Revue d'Ent. 26, p. 104.
Andrewes 1933, Ann. Mag. Nat. Hist. (10) 11, p. 110.

Description. A small, brownish testaceous *Perigona s.s.* with head and much of elytral discs darker brown, and with technical characters as indicated in preceding *Key to Species*; length *c.* 2.2–2.8 mm.

Types. Of *plagiata*, from **Aru** and **Kei Islands**, collected by Beccari, and from Andai, **West N. G.,** collected by Beccari and D'Albertis; in Genoa Mus. Of *annamita*, from **Ceylon**, **Annam**, **Singapore**, and Andai, **West N. G.,** the specimen(s) from New Guinea collected by Raffray; Andrewes (1933) found a "type" in the Maindron Collection, Paris Mus. Lectotypes for both *plagiata* and *annamita* should be fixed by the next reviser, after examination of all the original type material. (Types not seen.)

Occurrence in New Guinea. Common and widely distributed. I have seen 145 specimens from localities scattered over most of the length of the island, from Dobodura to Sansapor; most at low altitudes but single specimens found at 1100 and 1200 m at Wau.

Notes. Andrewes (1930) records *plagiata* from a wide range, from **SE. Asia** and **Japan** across the **Malay Archipelago** to the **Philippines** and **New Guinea**, and Van Emden lists it from the **New Hebrides**. Csiki (1924) records it from Australia on the basis of specimens (which I have seen) in the Hungarian National Mus., but I think this is an error (see Darlington 1964, Psyche 71, p. 125). *Perigona rufilabris* (Macleay) of eastern Australia is a similar but larger species.

Perigona (*Trechicus*) *nigriceps* (Dejean)

Dejean 1831, Species Général Coléop. 5, p. 44 (*Bembidium*).
Csiki 1931, Coleop. Cat., Carabidae, Harpalinae 5, p. 897 (see for synonymy and additional references).
Jedlicka 1935, Neue Carabiden aus Ostasien, Part 10, p. 18 (in key).
——— 1964, Reichenbachia 2, No. 61, pp. 268, 270, fig. 2.
Jeannel 1941, Rev. française d'Ent. 8, p. 141.
litura Perroud and Montrousier 1864, Ann. Soc. Linnéenne Lyon 11, p. 72 (*Trechus*) (new synonymy).
beccarii Putzeys 1875, Ann. Mus. Civ. Genoa 7, p. 732 (new synonymy).
biroi Csiki 1924, Ann. Mus. National Hungary 21, p. 173 (new synonymy).
klickai Jedlicka 1935, Neue Carabiden aus Ostasien, Part 10, pp. 18, 19 (new synonymy).

Description (for recognition only). See preceding *Key to Species of Perigona of New Guinea*; color *either* testaceous with head and apices of elytra darker, *or* brownish castaneous with suture (and of course appendages) pale, *or* intermediate with elytral disc partly but not entirely clouded; technical characters include eyes relatively large and prominent, front isodiametrically microreticulate, and elytra more conspicuously 3-punctate than usual in the genus, with posterior puncture usually almost in line with the others; length *c.* 2.5–3.0 mm.

Types. Of *nigriceps*, from **North America**, sent to Dejean by Leconte; now in Oberthür Coll., Paris Mus. Of *litura*, from Kanala, **New Caledonia**; location of type(s)

unknown. Of *beccarii*, from Sarawak, **Borneo**, collected by Doria and Beccari; now in the Genoa Mus. (a lectotype should be designated by next reviser). Of *biroi*, I now designate as lectotype a ♀ from Madang (Friedrich-Wilh.-hafen), **N-E. N. G.**, 1896 (Biró, Hungarian National Mus.); this specimen is from Csiki's original series and is labeled "Holotypus," but the designation has not been published until now. Of *klickai*, from Mt. Makiling, **Luzon**; in Andrewes Coll., British Mus. (Types of *biroi* and *klickai* only seen.)

Occurrence in New Guinea. Common and widely distributed at low altitudes: more than 160 specimens from many localities, from Milne Bay to "Dorey" and Biak Is., and including Dobodura and Wau (to 1300 m).

Notes. P. nigriceps is **cosmopolitan**, carried by man to all tropical and warm temperate regions.

P. litura, described from New Caledonia but supposedly widely distributed in the Malay Archipelago, was unknown to Andrewes. The description fits the dark form of *nigriceps*, and the fact that the type(s) occurred under vegetable detritus also fits *nigriceps*. (The habitat of *nigriceps* is noted under the genus.) *P. beccarii* is another name for the dark form of this species (I do not consider the dark form worth distinguishing by name), and *biroi* and *klickai*, of which I have seen the types, are also based on dark examples of *nigriceps*.

Perigona (Trechicus) erimae Csiki

Csiki 1924, Ann. Mus. National Hungary 21, p. 173.

Description (for recognition only). With characters of *Perigona*, subgenus *Trechicus*; broad, moderately convex; black or castaneous with suture usually not paler; eyes forming *c.* right angles with neck, but somewhat variable; front with or without (lightly impressed) isodiametric reticulations; prothorax with sides not or slightly sinuate posteriorly, with angles well defined but obtuse; elytra not or faintly striate, with little or no punctulation, with submarginal channel moderately broad behind puncture-triangle; length *c.* 3.2–3.6 mm.

Type. From Erima, Astrolabe Bay, **N-E. N. G.**, 1896 (Biró); in Hungarian National Mus. (seen).

Occurrence in New Guinea. Thirty-four specimens from numerous localities in **eastern and central New Guinea**, from Milne Bay and Dobodura to Hollandia and Cyclops Mts.; not yet found farther west in New Guinea; most from low altitudes but reaching 1200 m at Wau.

Notes. Specimens of this species vary considerably. The eyes vary in size and in development of genae but usually form nearly right angles with the neck. Reticulate microsculpture of the head may be distinct (but light), or partly obliterated, or *c.* absent. And there is some variation of other characters. However, the variation is not primarily geographic, but occurs at single localities. I think, but cannot be quite sure, that only one variable species is involved.

Csiki's type of *erimae* is large, with eyes large and genae slight, and with the front distinctly reticulate. Proportions of the type are head 0.83 width prothorax; prothoracic width/length 1.50, base/apex 1.03; width elytra/prothorax 1.53.

Although *erimae* is known only from New Guinea, somewhat similar but apparently distinct species (*andrewesi* Jedlicka, *arrowi* Jedlicka) occur in the Philippines.

Perigona (Trechicus) ludovici Csiki

Csiki 1924, Ann. Mus. National Hungary 21, p. 174.

Description (for recognition only). Form of *Perigona*, subgenus *Trechicus*; small; dark, like dark *nigriceps* but suture not or not conspicuously reddish; head with eyes smaller than in *nigriceps*, front less distinctly reticulate and with reticulations more transverse especially posteriorly; elytra with 3rd (posterior) punctures nearer suture; length *c.* 2.7–3.3 mm.

Types. Lectotype (present designation) from Mt. Hansemann, Astrolabe Bay, **N-E. N. G.**, 1901 (Biró, Hungarian National

Mus.), and 8 additional original (co)types, 2 with same data as lectotype and 6 from Madang (Friedrich-Wilh.-hafen), 1900 and 1901 (Biró) (seen).

Occurrence in New Guinea. Seventy-five specimens from numerous localities over almost the whole length of **New Guinea** (Milne Bay and Dobodura to the Vogelkop); at low altitudes, none above 550 m.

Notes. *P. ludovici* is compared with *nigriceps* in the preceding *Description*. *P. ludovici* is in fact closer to *erimae* but has the head narrower, eyes relatively smaller, and microreticulation of *posterior* part of head usually more transverse. Also, *ludovici* averages smaller than *erimae*, although measurements of length overlap: *ludovici*, *c.* 2.7–3.3; *erimae*, *c.* 3.2–3.7 mm. (Csiki gives 2.5–2.8 mm for *ludovici* and 3.5 mm for *erimae*.) Nevertheless, these species are very similar and some individuals are difficult to place. Proportions of the lectotype of *ludovici* are head 0.76 width prothorax; prothoracic width/length 1.49, base/apex 1.08; width elytra/prothorax 1.59.

Both *erimae* and *ludovici* live among dead leaves on the ground in rain forest.

Perigona (*Trechicus*) *lebioides* Csiki

Csiki 1924, Ann. Mus. National Hungary 21, p. 174.

Description (for recognition only). Form of small, very broad, moderately convex *Perigona*, subgenus *Trechicus*; castaneous with suture not or only faintly reddish; prothorax with sides not strongly sinuate and not denticulate posteriorly; elytra with submarginal depressed space very narrow behind puncture-triangle; elytra faintly or irregularly striate, not or not much punctulate; length 2.8–3.3 mm.

Types. I now designate as lectotype the specimen marked "Holotypus" by Csiki. It is from Erima, Astrolabe Bay, **N-E. N. G.,** 1896 (Biró) in Hungarian National Mus. (seen). Seven paratypes are from Sattelberg, N-E. N. G., 1899 (Biró). (Two additional specimens labeled as paratypes of *lebioides*, from Simbang, Huon Gulf, Biró, in Hungarian National Museum, are not *lebioides* but *erimae*.)

Occurrence in New Guinea. Sixty-one specimens (including 44 from Dobodura) from localities in all 3 political divisions of **New Guinea**; most at low altitudes but 1 from Sibil, Star Rge., at 1260 m (Leiden Mus.).

Notes. This, like the other small *Perigona* of subgenus *Trechicus* that occur in New Guinea, lives among dead leaves on the floor of rain forest. Biró presumably collected the types by sifting. I took mine by throwing raked-up leaves and leaf mold into still water, and picking up the beetles as they came to the surface.

Perigona (*Trechicus*) *cordens* n. sp.

Description. With characters of *Perigona*, subgenus *Trechicus*; form broad, rather convex; black or castaneous, suture not or not much paler, elytra subiridescent, appendages reddish testaceous; reticulate microsculpture faint, not clearly visible at *c.* 100 × but apparently isodiametric on front, somewhat transverse posteriorly on head, fine and strongly transverse on pronotum and elytra. Head 0.80 and 0.79 width prothorax; eyes rather large, forming *c.* right angles with neck, mandibles average for genus; antennae with middle segments *c.* 1½ × long as wide; front with impressions irregular but distinct, margined externally by short elevations. *Prothorax* cordate; width/length 1.47 and 1.47; base/apex 0.98 and 0.97; sides strongly sinuate about ⅛ from base; posterior angles nearly right but blunted; disc with fine middle line, shallow poorly defined baso-lateral impressions. *Elytra* short, wide; width elytra/prothorax 1.64 and 1.66; submarginal impressed space very narrow behind puncture-triangle; each elytron with parts of at least 6 striae, inner ones moderately impressed and irregular or vaguely punctate; intervals not distinctly punctulate, 3rd 3-punctate. *Secondary sexual characters* normal: ♂ front tarsi with 3 segments (only apex of 1st) narrowly 2-seriately squamulose; ♂ with 2, ♀ *c.* 4

setae at apex last ventral segment. *Measurements*: length *c.* 3.4; width 1.5–1.6 mm.

Types. Holotype ♂ (M.C.Z., Type No. 31,345) and 3 paratypes (broken ♂, ♀ ♀) all from Dobodura, **Papua**, Mar.–July 1944 (Darlington).

Measured specimens. The ♂ holotype and 1 ♀ paratype.

Notes. This species occurred in leaf litter in rain forest, with *erimae, ludovici,* and *lebioides,* from all of which *cordens* is immediately distinguishable by its strongly cordate prothorax.

Perigona (Trechicus) dentifer n. sp.

Description. With characters of *Perigona,* subgenus *Trechicus*; form as in Figure 3; broad, moderately convex; reddish castaneous with suture slightly paler, appendages reddish testaceous; shining, not iridescent, microsculpture absent or nearly so. *Head* 0.78 and 0.78 width prothorax; mandibles slender, pointed, weakly arcuate near apex; eyes moderately large but less prominent than usual, forming obtuse angles with neck; antennae with middle segments *c.* 1½ × long as wide; front with slight median puncture and distinct short anterior frontal impressions. *Prothorax* broadly subcordate, very wide anteriorly; width/length 1.40 and 1.45; base/apex 0.95 and 0.88; sides weakly rounded, strongly converging posteriorly almost to base, then abruptly sinuate with basal angles right-denticulate; disc with usual middle line and transverse impressions, basal transverse impression subfoveate at middle and running into slightly deeper but poorly defined baso-lateral impressions. *Elytra* wide; width elytra/prothorax *c.* 1.61 and 1.60 (exact measurement impossible because elytra spread in both specimens); submarginal impressed space very narrow behind puncture-triangle; 6 abbreviated striae on each elytron, inner ones impressed, all plainly punctate; intervals not punctulate, 3rd 3-punctate. *Secondary sexual characters* as in preceding species (*cordens*). *Measurements*: length *c.* 3.2–3.4; width *c.* 1.4–1.5 mm.

Types. Holotype ♂ (M.C.Z., Type No. 31,346) and 1 ♀ paratype both from Milne Bay, **Papua**, Dec. 1943 (Darlington).

Notes. The form of prothorax, absence of microsculpture, and impressed punctate elytral striae are diagnostic of this species.

Tribe LICININI

Sloane 1898, Proc. Linnean Soc. New South Wales 23, pp. 487 ff. (Australian genera).
Csiki 1931, Coleop. Cat., Carabidae, Harpalinae 5, p. 899.
Ball 1959, Mem. American Ent. Soc., No. 19, p. 5 (see for synonymy and additional references).

Most Licinini, including all those known from New Guinea, have the labrum and usually also the clypeus deeply emarginate, the labrum often so deeply so as to appear 2-lobed. This alone is almost a sufficient recognition character of the tribe, in New Guinea. Other diagnostic characters are discussed by Ball (1959, pp. 5–8).

Licinines are nearly world-wide in distribution but are relatively few in Central and South America and relatively numerous in Australia: about 10 genera, including some that are probably primitive or relict, occur in Australia. Five genera occur in New Guinea: *Badister*, which is widely distributed in other parts of the world; *Omestes*, a monotypic genus confined to the eastern part of the Malay Archipelago; and *Physolaesthus, Dicrochile,* and *Microferonia,* which are primarily Australian. Three species of *Dicrochile* and one of each of the other genera are known in New Guinea. All the New Guinean species are winged, except *Microferonia baro.*

The following *Key* is based on Ball's (1959, p. 11) key to Oriental licinine genera.

KEY TO GENERA OF LICININI OF NEW GUINEA

1. One mandible deeply notched above, with a prominent boss behind the notch 2
– Neither mandible notched as described 4
2. Left mandible notched; only basal segment of antenna glabrous (p. 15) ..... *Badister*
– Right mandible notched; each antenna with 3 segments glabrous 3
3. Smaller (*c.* 5 mm); elytra not spined (p. 15) ..... *Physolaesthus*

– Larger (*c.* 11–15 mm); elytra with short apical spines (p. 16) *Omestes*

4. Form *Agonum*-like; mandibles blunt at apex (p. 16) *Dicrochile*

– Form elongate-oval with very small head; mandibles (at least the right one) conspicuously 2-dentate at apex, with upper tooth large, acute (p. 18) *Microferonia*

Genus *BADISTER* Clairville

Anonymous [Clairville] 1806, Entomologie Helvetique 2, p. 90.
Csiki 1931, Coleop. Cat., Carabidae, Harpalinae 5, p. 901 (see for synonymy and additional references).
Jeannel 1942, Faune de France, Coléop. Carabiques, Part 2, p. 1000.
Louwerens 1956, Treubia 23, p. 236 (key to Indonesian species).
Ball 1959, Mem. American Ent. Soc., No. 16, pp. 189–191.

Diagnosis. See preceding *Key.*

Description. None required here.

Type species. Carabus bipustulatus Fabricius, of Europe, etc.

Generic distribution. Temperate and tropical **Eurasia**, the **Malay Archipelago**, and eastern **Australia**; **Africa** and **Madagascar**; **North America** and some **West Indies**, but not South America.

Notes. See Jeannel (1942) and Ball (1959) for further information on this widely distributed genus.

Badister (*Baudia*) *sundaicus* Andrewes

Andrewes 1926, Ann. Mag. Nat. Hist. (9) 18, p. 275.
Louwerens 1956, Treubia 23, p. 236.

Description. See Andrewes (1926); length *c.* 4.0–4.5 mm.

Type. From Soekaboemi, **Java**; in Andrewes Coll., British Mus. (seen).

Occurrence in New Guinea. **Papua**: 4, Dobodura, Mar.–July 1944 (Darlington). **N-E. N. G.**: 1, Maprik, Sepik Dist., 150 m, Dec. 29, 1959–Jan. 17, 1960 (T. C. Maa, Bishop Mus.). **West N. G.**: 2, Hollandia, July–Sept. 1944 (Darlington).

Notes. I tentatively identify as *sundaicus* specimens from **Siam** and the **Malay Pen.** (British Mus.); **Sumatra**; **Java**; Luzon and Leyte in the **Philippines**; Morotai Is. in the **Moluccas**; **New Guinea** (listed above); **New Britain**; and widely scattered localities in eastern **Australia**. Specimens from all these places have the mandibular and antennal characters indicated in the preceding *Key to Genera.* However, variation is obvious, and further study may show that more than one species is involved.

Specimens of this and related species that I have collected were usually among dead leaves and vegetation on the ground in very wet places by standing (not running) water.

Genus *PHYSOLAESTHUS* Chaudoir

Chaudoir 1850, Bull. Soc. Nat. Moscow 23, Part 1, No. 2, p. 411.

Diagnosis. See preceding *Key to Genera.*

Description. See Chaudoir (1850), and following *Notes.*

Type species. P. australis Chaudoir, of Australia.

Generic distribution. Primarily **Australia**; one species described from **New Zealand**; and the following species (if correctly assigned) on **New Guinea**, **Java**, and the **Philippines**.

Notes. I have not been able to identify *australis* in the Australian material before me. Chaudoir does not describe its antennal pubescence but states that the right mandible is tuberculate, and this character is always associated with 3 antennal segments glabrous, among Australian licinines known to me. Whether the following species is really a *Physolaesthus* and how this genus is related to *Badister* will have to be decided by future revisers.

Physolaesthus caviceps (Andrewes)

Badister caviceps Andrewes 1936, Ann. Mag. Nat. Hist. (10) 17, p. 312
Louwerens 1956, Treubia 23, p. 236.

Description. See Andrewes, and my Figure 4; length *c.* 5 mm.

Type. A ♀ from Toeloengagoeng, **Java**; in Andrewes Coll., British Mus. (seen).

Occurrence in New Guinea. **West N. G.**: 4, all from Wissel Lakes area, as follows:

1, Itouda, Kamo Vy., 1500 m, Aug. 12, 1955 (Gressitt), in light trap; 1, Lake Paniai, 1570 m, Aug. 28, 1939 (H. Boschma, Leiden Mus.); 2, Enarotadi, 1800 m, Aug. 1, 1962 (Sedlacek).

Notes. I have seen specimens with the characters of *caviceps* from Java and Luzon as well as New Guinea but am not sure whether they represent one species or two or more related species. Except for the different mandibles and antennae, this species is remarkably similar to *Badister sundaicus* (above), and I think the habitats of the two species are similar, judging from what I have seen of them in the Philippines.

Genus *OMESTES* Andrewes

Andrewes 1933, Treubia 14, p. 276.

Diagnosis. See preceding *Key to Genera.*

Description. See Andrewes.

Type species. Omestes torta Andrewes, below.

Generic distribution. Same as that of *O. torta*, below.

Notes. I suspect that *Omestes torta* may prove to be only a large, specialized (spined) *Physolaesthus*, but I shall leave a decision about this to future revisers.

Omestes torta Andrewes

Andrewes 1933, Treubia 14, p. 277.
Louwerens 1956, Treubia 23, p. 224.

Description. See Andrewes, and my Figure 5; length 11–14 mm.

Type. A ♂ from **Sangi Is.**; in Andrewes Coll., British Mus. (seen).

Occurrence in New Guinea. **Papua**: 1, Dobodura, Mar.–July 1944 (Darlington); 1, Milne Bay, Dec. 1943 (Darlington); 2, Kiunga, Fly R., Aug. 14–17, 1957 (W. W. Brandt, Bishop Mus.); 1, Daru Is., Mar. 16–31, 1936 (Archbold Expedition, A.M.N.H.); 1, Woodlark Is. (Murua), Kulumadau Hill, Apr. 16–22, 1957 (W. W. Brandt, Bishop Mus.). **West N. G.**: 19, Hollandia, July–Sept. 1944 (Darlington); 1, Maffen, Tor R. (mouth), 4 km E. of Hollandia, July 2, 1959 (T. C. Maa, Bishop Mus.), at light; 1, Bernhard Camp, 50 m, Apr. 12, 1939 (Toxopeus).

Notes. Omestes torta is now known from **New Guinea**, the **Moluccas** (Halmahera and Morotai), **Celebes**, the **Sangi** and **Talaud Islands**, and the **Philippines** (Leyte). My material is not sufficient to show details of geographic variation. The insect lives among dead leaves and vegetation on the ground in deep swamps.

Genus *DICROCHILE* Guérin

Guérin 1846, Ann. Soc. Ent. France (2) 4, Bull. p. CIII.
Sloane 1923, Proc. Linnean Soc. New South Wales 48, pp. 35–36 (key to Australian species).
Csiki 1931, Coleop. Cat., Carabidae, Harpalinae 5, p. 921 (see for synonymy and additional references).

Diagnosis. See preceding *Key to Genera.*

Description. None required here.

Type species. Presumably *Dicrochile fabrii* Guérin, of New Zealand. (I do *not* wish to designate a type species. If no formal designation has been made, it should be left to the next reviser.)

Generic distribution. **New Zealand**, **Australia**, **New Guinea**, **Moluccas** (Obi Is.), **Solomons** (a probably undescribed species near *alternans* from Bougainville), **New Caledonia**.

Notes. All species of this genus that I know, in Australia as well as New Guinea, are winged. Most of them live in swamps or other wet places, but *alternans* (described below) is a mesophile.

KEY TO SPECIES OF *DICROCHILE* OF NEW GUINEA

1. Elytra with acute teeth or short spines at sutural and outer-apical angles; dorsal elytral intervals equal or nearly so (p. 16) *acuta*
– Elytra not toothed or spined; dorsal elytral intervals unequal 2
2. Front of head normally convex; smaller, length 11.5–12.5 mm (p. 17) *alternans*
– Front of head slightly depressed; larger, length 13.5–14.5 mm (p. 18) *tiro*

Dicrochile acuta n. sp.

Description. Form (Fig. 6) of *Agonum*-like *Dicrochile*; piceous black, lateral margins of pronotum and elytra slightly trans-

lucent, elytra iridescent; microsculpture fine and isodiametric on front, indistinct (at 100×) but probably strongly transverse on pronotum and elytra. *Head* 0.74 and 0.72 width prothorax; eyes large; front slightly convex, weakly impressed at sides anteriorly. *Prothorax* quadrate-subcordate; width/length 1.35 and 1.39; base/apex 1.13 and 1.09 (base measured across posterior-lateral setae); base slightly emarginate, not margined; apex broadly emarginate, with impressed marginal line; sides rounded except *c.* straight toward base; margins rather broad, moderately explanate, each with usual 2 setae (at base and before middle); basal angles very obtuse, almost rounded; pronotum with usual impressions, impunctate at middle, closely punctate at base and sides. *Elytra* subparallel, slightly narrowed toward base; width elytra/prothorax 1.46 and 1.40; outer-apical and sutural angles each with an acute tooth or very short spine; striae shallow, faintly punctulate; intervals *c.* flat, subequal on disc, 3rd with 2 punctures attached to 2nd stria. *Legs*: middle and hind tarsi broadly grooved each side above; 5th segment hind tarsi with *c.* 6 strong setae each side below. *Secondary sexual characters*: ♂ front tarsi somewhat obliquely dilated, with 3 segments squamulose below; ♂ with 1, ♀ with 2 setae before apex each side last ventral segment. *Measurements*: length *c.* 12.5–15.5; width *c.* 5.0–6.4 mm.

Types. Holotype ♂ (A.M.N.H.) and 1 ♀ paratype (M.C.Z., Type No. 31,347) from Lake Daviumbu, Fly R., **Papua**, Sept. 1–10 (holotype) and Aug. 19–30 (paratype), 1936 (Archbold Exp.), evidently taken in a light trap; 1 ♀ paratype (Bishop Mus.), Oriomo R., **Papua**, 6 m, Feb. 13, 1964, "H. C.", in light trap; 1 ♀ paratype, "Highl. Agr. Exp. Sta./Aiyura, E. Highl./D", **N-E. N. G.,** 5600 ft. (*c.* 1700 m), May 26, 1960 (J. J. H. Szent-Ivany, Dept. Agr. Port Moresby), at light; 1 ♂ paratype (Bishop Mus.), Nabire, S. Geelvink Bay, **West N. G.,** 10–40 m, Oct. 7, 1962 (H. Holtmann), in light trap in jungle.

Measured specimens. The ♂ holotype and ♀ paratype from Lake Daviumbu.

Notes. This species is closely comparable only with *D. gigas* Castelnau, of Australia. It resembles *gigas* in most technical characters including the denticulate-spinose elytra, but differs from *gigas* in being much smaller (Australian *gigas* measure 20 mm and over) and in having a relatively narrower prothorax and less impressed front.

Louwerens (Treubia 24, 1958, p. 250) records *D. gigas* from Obi Is. in the Moluccas, on the basis of 2 specimens 18 mm long, which differ in some details from the single Australian specimen of *gigas* with which they were compared. Whether the Obi Is. specimens are *gigas* or a related species remains to be decided, as Louwerens hints.

Dicrochile alternans n. sp.

Description. Form (Fig. 7) of rather broad Australian *Dicrochile* (e.g., *goryi* Boisduval); black, appendages blackish except outer segments of antennae brown; both sexes moderately shining but not iridescent, with reticulate microsculpture faint and *c.* isodiametric (where detectable) on front, vague or irregular but apparently transverse on pronotum and elytra. *Head* 0.74 and 0.73 width prothorax; eyes moderate; front convex at middle, irregularly longitudinally impressed each side anteriorly. *Prothorax* slightly transverse, width/length 1.36 and 1.38; base/apex 1.15 and 1.15; base and apex broadly emarginate, apex strongly and base less strongly or indistinctly margined; sides broadly rounded; margins broadly flattened and moderately reflexed posteriorly, each with usual 2 setae, at base and before middle; basal angles broadly rounded; disc convex, with usual impressions, punctate at base, sides, and apex, impunctate at middle. *Elytra* elongate-subquadrate; width elytra/prothorax 1.48 and 1.54; apices sinuate but not denticulate; striae deep, punctulate; intervals convex, unequal on disc (3rd, 5th, 7th nearly 2× as wide as others at ⅔ of elytral length), 3rd usually 2-punctate with

punctures near or behind ⅓ and ⅔ of elytral length, but anterior puncture sometimes duplicated on one or both elytra. *Legs*: middle and hind tarsi sulcate each side above; 5th segments hind tarsi with *c.* 6 strong setae each side below. *Secondary sexual characters*: ♂ front tarsi dilated and squamulose as usual in genus; ♂ with 1, ♀ 2 setae each side last ventral segment. *Measurements*: length *c.* 11.5–12.5; width 4.5–5.0 mm.

Types. Holotype ♂ (M.C.Z., Type No. 31,348) and 12 paratypes from Chimbu Vy., Bismarck Rge., **N-E. N. G.,** 5000–7500 ft. (*c.* 1500–2300 m), Oct. 1944 (Darlington); 1 paratype, Feramin, **N-E. N. G.,** 1200–1500 m, June 15–18, 1959 (W. W. Brandt, Bishop Mus.); 1 paratype, Minj, W. Highlands, **N-E. N. G.,** 5200 ft. (*c.* 1600 m), May 20, 1960 (J. H. Barrett, Dept. Agr. Port Moresby), by mercury vapor lamp.

Additional material. **Papua**: 1 ♂, S. Highlands, Aiyuro nr. Mendi, 1530 m, Oct. 7, 1958 (Gressitt), in light trap. **West N. G.**: 1 ♂, Wissel Lakes, Urapura-Itouda, Kamo Vy., 1500 m, Aug. 12, 1955 (Gressitt).

Measured specimens. The ♂ holotype and 1 ♀ paratype from Chimbu Vy.

Notes. The usually 2-punctate 3rd elytral intervals and the deep, punctulate striae suggest that this new species is allied to the common Australian *Dicrochile goryi* Boisduval, but the elytral intervals of *goryi* do not alternate in width, and there are other smaller differences.

I found the Chimbu specimens under cover on the ground in fairly open places.

Dicrochile tiro n. sp.

Description. Similar to the preceding (*alternans*) but larger, with flatter front and relatively wider prothorax. *Head* 0.71 and 0.69 width prothorax, formed as in *alternans* except flatter anteriorly. *Prothorax*: width/length 1.39 and 1.45; base apex 1.16 and 1.16; otherwise as in *alternans*. *Elytra*: width elytra/prothorax 1.47 and 1.40; most details including alternation of elytral intervals *c.* as in *alternans*; 3rd interval 2- to 4-punctate, the number of punctures often different on the 2 elytra of 1 individual (actual punctures on the left and right elytra of 6 individuals are 2–3, 2–2, 4–2, 2–2, 2–2, 2–3). *Measurements*: length 13.5–14.5; width 5.5–6.1 mm.

Types. Holotype ♀ (Leiden Mus.) and 7 paratypes (some in M.C.Z., Type No. 31,349) all from Wissel Lakes, **West N. G.,** as follows: holotype and 4 paratypes, Lake Paniai, 1750 m, and 1 paratype, Arabu Camp, 1800 m, various dates in Sept., Oct., Nov. 1939 (H. Boschma, Leiden Mus.); 2 paratypes, Enarotadi, 1800–1900 m, July 31, Aug. 9, 1962 (Sedlacek).

Measured specimens. One ♂ paratype from Lake Paniai and the ♀ holotype, in this order.

Notes. Sufficiently compared with *alternans* in the preceding *Description* and in the *Key to Species of Dicrochile of New Guinea.* Whether *tiro* is a separate species or a local form of *alternans* is uncertain. The matter is complicated by the occurrence of a specimen of *alternans* in the Wissel Lakes area.

Genus *MICROFERONIA* Blackburn

Blackburn 1890, Proc. Linnean Soc. New South Wales (2) 4, p. 738.

Sloane 1898, Proc. Linnean Soc. New South Wales 23, pp. 490–491 (Australian species).

Csiki 1931, Coleop. Cat., Carabidae, Harpalinae 5, p. 920 (see for additional references).

Genycerus Andrewes 1933, Treubia 14, p. 277 (new synonymy).

Diagnosis. See *Key to Genera of Licinini.*

Description. None required here; see *Notes*, below.

Type species. Of *Microferonia, M. adelaidae* Blackburn, Australia; of *Genycerus, G. lucanoides* Andrewes, of Java.

Generic distribution. **Australia**, **New Guinea**, **Java**, and presumably intervening islands.

Notes. When Andrewes described *Genycerus*, he thought the mandibles unique among Licinini, but he was not familiar with the Australian members of the tribe. I have seen the type of *Genycerus lucanoides*

and have a photograph of it, and it seems to me that the mandibles are comparable to those of *Microferonia*. The discovery of another comparable species in New Guinea links the Australian and Javan forms geographically. I therefore tentatively suggest the synonymy cited above.

Microferonia baro n. sp.

Description. Form as in Figure 8, elongate-oval with very small head; brownish piceous, legs and antennae slightly reddish; moderately shining, reticulate microsculpture *c.* isodiametric on front, transverse on pronotum, more transverse on elytra. *Head* 0.51 width prothorax; eyes large, genae short; 2 setae over each eye; antennae with 3 basal segments glabrous; right mandible 2-dentate, with inner tooth strong and acute (left mandible probably *c.* similar but partly hidden); front almost evenly convex except with slight frontal impressions anteriorly; clypeus subtruncate, with narrow transverse membrane; labrum emarginate to *c.* middle of length, with lobes equal; mentum without tooth; ligula and paraglossae apparently subequal, ligula apparently 2-setose; palpi slender except apical segments of both pairs slightly thickened. *Prothorax*: width/length 1.40; base/apex 1.70; base truncate-emarginate, vaguely margined at middle; apex broadly emarginate, with marginal line entire; sides rounded anteriorly, nearly straight toward base, narrowly margined, each with 2 setae, at base and before middle; disc broadly convex except depressed baso-laterally, impunctate, with middle line distinct but transverse impressions *c.* obsolete. *Elytra* long-oval; width elytra/prothorax *c.* 1.30; margins entire at base, bluntly (almost rectangularly) angulate at humeri, not distinctly sinuate toward apex; sutural angles narrowly rounded; striae fine, irregular but scarcely punctulate; intervals nearly flat, somewhat irregular but scarcely alternating; each 3rd interval with a conspicuous seta-bearing puncture about ⅓ from base, a less conspicuous puncture without seta near or behind middle, apparently no more-posterior puncture. *Inner wings* evidently atrophied. *Lower surface* almost impunctate but extensively alutaceous, not pubescent; metepisterna less than ½ longer than wide. *Legs*: tarsi slender, not sulcate above; 5th segments hind tarsi with 5 long setae each side below. *Secondary sexual characters*: ♂ with 3 segments each front tarsus moderately dilated, squamulose below; ♂ with 1 seta each side last ventral segment; ♂ copulatory organs as in Figure 170; ♀ unknown. *Measurements*: length *c.* 8; width 3.4 mm.

Type. Holotype ♂ (M.C.Z., Type No. 31,350) from Mt. Wilhelm, Bismarck Rge., **N-E. N. G.,** 7000–10,000 ft. (2135–3050 m), Oct. 1944 (Darlington); the type is unique. It was taken on the ground under cover in mountain rain forest.

Notes. Microferonia baro is more oval and smaller-headed than *M.* (*Genycerus*) *lucanoides* (Andrewes) of Java. I do not have a specimen of *lucanoides*, and I do not want to dissect the mouth parts of the single type of *baro* (which should be reserved for specialists in Licinini), but so far as I can determine the two species are similar in generic characters although different in detail. *M. baro* is larger, more oval, and smaller-headed than any Australian *Microferonia* known to me.

(Tribe AMBLYSTOMINI)

(Genus *AMBLYSTOMUS* Erichson)

Erichson 1837, Käfer Mark Brandenburg 1, 1, p. 59.

Csiki 1931, Coleop. Cat., Carabidae, Harpalinae 5, p. 922 (see for synonymy and additional references).

Andrewes 1939, Ann. Mag. Nat. Hist. (11) 3, p. 130.

Diagnosis. Small Carabidae with most technical characters of large-headed Harpalini but with labrum usually unsymmetrically emarginate and scutellar striae in first (not second) intervals; length usually less than 5 mm.

Description. None required here.

Type species. Acupalpus mauritanicus Dejean, of the Mediterranean region (Andrewes 1939).

Generic distribution. Most of the warmer parts of the **Old World**, including **Australia** but perhaps not New Guinea.

Notes. In the British Museum are 14 specimens labeled as from Dor(e)y, New Guinea, some marked as collected by Wallace and all probably from his material. They include 4-maculate, 2-maculate and immaculate individuals, probably representing different species. However, these specimens may be mislabeled and may really be from Celebes or the Moluccas (see Part I of my "Carabid Beetles of New Guinea," p. 331). I have received no other specimens from New Guinea and found none there myself, although I collected series of the genus in the Philippines, so that my collecting methods are evidently adequate to obtain it, and *Amblystomus* is usually common where it occurs at all. I therefore doubt its occurrence in New Guinea. I list the genus here, in parentheses, but see no reason to name or discuss the "Dor(e)y" species individually.

Tribe CHLAENIINI

Csiki 1931, Coleop. Cat., Carabidae, Harpalinae 5, p. 927 (see for earlier references and synonymy).

Callistitae Jeannel 1942, Faune de France, Coléop. Carabiques, Part 2, p. 961.

Jeannel 1949, Coléop. Carabiques de la Région Malgache, Part 3, p. 776.

Callistinae Basilewsky 1953, Exploration Parc National l'Upemba, Fasc. 10, Carabidae, p. 119.

A single, well known genus of this tribe is represented in New Guinea.

Genus *CHLAENIUS* Bonelli

Bonelli 1810, Observations Ent. 1, Tab. Synopt., Mem. Acad. Sci. Turin 18, pp. 21–78.

Chaudoir 1876, Ann. Mus. Civ. Genoa 8, p. 10 (in monograph of "Chleniens").

Sloane 1910, Proc. Linnean Soc. New South Wales 35, p. 437 (Australian species).

Csiki 1931, Coleop. Cat., Carabidae, Harpalinae 5, p. 934 (see for additional references).

Andrewes 1941, Ann. Mag. Nat. Hist. (11) 7, p. 307 (with key to Javan species).

Jeannel 1942; 1949 (see works cited under tribe).

Bell 1960, Misc. Pub. Ent. Soc. America 1, pp. 98, 108 (North American species).

Diagnosis. See works cited. I use *Chlaenius* in a very broad sense, as noted below. In this sense it is the only genus of the tribe in New Guinea and Australia.

Description. None required here. For discussion of some characters of the New Guinean species, see *Notes* below.

Type species. Chlaenius marginatus Rossi (= *velutinus* Duftschmidt), of Europe.

Generic distribution. Nearly **world-wide**. The genus is most diverse in structure and most numerous in species in Africa and the Oriental Region, less diverse and less numerous in Eurasia and America north of the tropics, and still less in South America and the Australian Region. This suggests that the genus has evolved primarily in the Old World tropics and spread from there.

In the Asiatic-Australian area, scores of species of *Chlaenius* are known in tropical Asia, about 30 in Java (Andrewes 1941), but only 12 in New Guinea, and only 10 (including *Hololeius*) in Australia. Some of the species in New Guinea and Australia are undifferentiated Asiatic forms. Others are endemic to New Guinea or Australia. And the endemics differ in degree of distinctness. This suggests continual trickling of species from Asia toward New Guinea and Australia rather than concerted movements. The fact that all *Chlaenius* in New Guinea and Australia are still winged suggests that their dispersals have been relatively recent.

Notes. For discussion of the author, date of publication, and type species of *Chlaenius* see Jeannel 1942, page 963, footnote.

Chlaenius is a huge genus of 700 or 800 or more known species, and the species are diverse and can be divided into many well characterized groups. Nevertheless, the genus as a whole seems natural, not polyphyletic. Under these circumstances, although the genus can and should be subdivided, the taxonomic level of the subdivisions should be determined by utility and intelligibility. *Chlaenius* is known to

many entomologists who are not specialists in Carabidae, and there seems much to lose and little to gain by splitting it into small genera with new and unfamiliar generic names, many of them unfamiliar even to me, a specialist in Carabidae! I shall therefore use *Chlaenius* in a very broad sense, as a matter of considered policy. I expect to discuss this policy in more detail in Part IV of my "Carabid Beetles of New Guinea." The *Chlaenius* of New Guinea are few and some of them do not fit well in recognized subgenera, and no one is likely to be misled if I treat them simply as species of the great genus *Chlaenius sensu lato*.

Almost every author who has worked extensively on *Chlaenius* has used new characters to group the species, but the works of different authors have not been well correlated. Chaudoir used a variety of obvious characters, beginning with extent of abdominal punctation. Sloane noted that presence or absence of a basal pronotal hair fringe and presence or absence of interruptions of the outer elytral margins are promising taxonomic characters within the genus. Jeannel and Basilewsky derived new group characters from the male genitalia. And Bell found additional characters in the labial pit organs of both sexes and in the chaetotaxy of the valvulae of the female.

The following notes on certain characters apply *only* to the New Guinean species of *Chlaenius*, unless otherwise indicated.

The mandibles are short in all *Chlaenius* in New Guinea, and are exceptionally strongly semicircularly arcuate in *maculiger*.

The clypeus and labrum are truncate or weakly emarginate except in *amplipennis*, in which the labrum is deeply emarginate.

The antennae have segment 3 much (*c.* ½) longer than segment 4 in *Chlaenius pan* and *daer*, slightly longer in *guttula* and *amplipennis*, and subequal in the other species. Segment 3 is pubescent in *guttula* (although the pubescence differs in quality from that on the outer segments), more sparsely pubescent or setulose in *pan* and *daer*, and still more sparsely so in the other species. Segment 3 is not strictly glabrous in any species; a few minute setules are always visible in fresh, clean specimens at 50× or 100× magnification.

The palpi (both pairs, in both sexes) are usually slender with apices narrowly truncate, but are almost acuminate in *guttula*, and more broadly truncate in *flaviguttatus* (terminal segments with apical edges ⅓ or ½ segments' length).

The mentum is toothed, and the tooth is usually variably emarginate.

The pronotum has a basal hair fringe in all species except *daer*, *ceylanicus*, and *guttula*, which lack it. These 3 species are apparently not related to each other.

The pronotum always has a pair of posterior-lateral and in some cases also median-lateral seta-bearing punctures, but they are often hard to distinguish in the general punctation. The posterior-lateral punctures are ⅕ or ⅙ of the prothoracic length before the base in *Chlaenius pan*, *daer*, and *guttula*, but closer to or at the posterior angles in the other species. Median-lateral punctures (just before middle of prothoracic length) are present in some (all?) individuals of *occultus* and *siccus*, but apparently absent in the other species.

The elytra have the basal margin entire except in *Chlaenius pan*. The margin is obtusely angulate at humeri in *daer*, rounded or at most vaguely subangulate in the other species.

The outer elytral margins are interrupted before apex *except* in *Chlaenius pan* and *daer*, in which the interruption is obsolete.

The punctation of the elytral intervals is 2-seriate in *Chlaenius pan* and *daer*, but irregular in the other species, in which it varies from sparse (*ceylanicus* only) to dense.

The inner wings are full and probably fit for flight in all *Chlaenius* in New Guinea and also in Australia, although wing atrophy has occurred in various African, Asiatic, and North American stocks of the genus.

The punctation of the lower surface of the body is more diverse than some authors

have realized. Almost the whole lower surface including the abdomen is punctate or punctulate and setulose in *Chlaenius guttula* and *amplipennis* and also in *daer*, although the latter belongs to the *circumdatus* group in which Andrewes (1941) considered the middle of the abdomen glabrous. *C. pan, ceylanicus*, and *maculiger* are more or less intermediate in this character. The other species have the middle of the abdomen widely glabrous.

The metepisterna are differently margined in different *Chlaenius* in New Guinea, but I doubt if this character deserves the importance Andrewes (1941) gives it.

The tarsi are obviously setulose above in *Chlaenius guttula*, glabrous or nearly so in the other species, but minute setules are usually visible on the upper surface of the tarsi at 50× or 100× magnification, even in the "glabrous" species.

The hind tarsi have the 5th segments always with 2 rows of strong setae below. The number of setae in each row varies from about 4 to about 8 in different species.

Males of all New Guinean species of *Chlaenius* have each front tarsus with 3 segments dilated (least so in *ceylanicus*, see following *Key*) and densely squamulose below. And ♂ ♂ have 1, ♀ ♀ 2 setae each side before apex of last ventral segment, with extra adventitious setae sometimes present.

The aedeagus is open above for much of its length in most species (especially widely open in *guttula*) but relatively long and closed for almost half its length in *pan*.

I have not studied the chaetotaxy of the ♀ valvulae.

Six unrelated species of *Chlaenius*, derived from groups that normally have pale markings on the elytra, are losing or have lost the markings in New Guinea (see *Notes* under *daer, guttula, flaviguttatus, bimaculatus pongraczi, maculiger*, and *hamifer malcheri*). This suggests a local climatic or other selective factor favoring dark color and loss of markings in New Guinea.

In habits, all New Guinean *Chlaenius* are ground-living. *C. daer, ceylanicus, bimaculatus pongraczi*, and *occultus* are found on river banks; *occultus* especially may occur only beside rivers. *C. hamifer malcheri* and *siccus* are commonly found under cover in comparatively dry places. *C. maculiger* is, I think, a rain forest species. The other species live in more or less damp places, but I cannot give their habitats exactly. I took specimens of several species at light or in floods.

Key to Species of *Chlaenius* of New Guinea

1. Elytra with outer margins not interrupted; elytral intervals each with 1 regular row of punctures on each side; antennae with 3rd segments *c.* ½ longer than 4th 2
– Elytra with outer margins interrupted before apex; elytral intervals irregularly punctate; antennae with 3rd segments not or not much longer than 4th 3
2. Very large (*c.* 25 mm); pronotum with basal hair fringe (p. 23) ..... *pan*
– Smaller (*c.* 12–15 mm); pronotum without basal hair fringe (p. 24) ..... *daer*
3. Elytral intervals very sparsely punctulate; ♂ front tarsi narrower, with 2nd segments ¼ or ⅓ longer than wide (p. 24) *ceylanicus*
– Elytral intervals more closely punctulate; ♂ front tarsi wider, 2nd segment *c.* wide as long 4
4. Mandibles very short, semicircularly arcuate (p. 25) *maculiger*
– Mandibles normal, moderately arcuate 5
5. Abdomen plainly punctulate and pubescent or setulose at middle as well as at sides 6
– Abdomen broadly smooth and glabrous (or nearly so) at middle 7
6. Labrum subtruncate or weakly emarginate; pronotum without basal hair fringe; posterior-lateral setae *c.* ⅙ of prothoracic length before base; size very small (*c.* 8 mm) (p. 25) *guttula*
– Labrum deeply emarginate; pronotum with basal hair fringe; posterior-lateral setae near (slightly rounded) posterior angles; larger (*c.* 12 mm) (p. 26) *amplipennis*
7. Male front femora each with a small tooth-like tubercle below, near base; 5th segments hind tarsi with *c.* 7 or 8 setae each side below 8
– Male front femora without tubercles; 5th segments hind tarsi with *c.* 5 setae each side below 10

8. Pronotum closely and coarsely punctate *and* head including front punctulate (this combination of characters separates both sexes of this species from all following ones, the closest approach being *siccus*, see couplet 10) (p. 26) ..... *flaviguttatus*
– Pronotum with only base coarsely punctate; head not or only sparsely irregularly punctulate 9
9. Pronotum with anterior margin entire or only narrowly interrupted at middle; sides of prothorax usually sinuate; elytra usually 2-maculate (p. 27) ..... *bimaculatus pongraczi*
– Pronotum with anterior margin obsolete, indicated only toward sides; sides of prothorax not sinuate; elytra not maculate (p. 27) ..... *olthofi*
10. Pronotum punctate at base and in narrow zone along midline but much of disc impunctate; posterior-lateral pronotal setae often *c.* 1/10 of pronotal length before angles (but variable) (p. 28) ..... *occultus*
– Pronotum more extensively (but not always evenly) punctate; posterior-lateral pronotal setae almost at basal angles 11
11. Pronotum more sparsely punctate near middle, with punctures tending to form irregular longitudinal rows; front extensively but irregularly punctate (p. 28) ..... *hamifer malcheri*
– Pronotum coarsely punctate, with punctures somewhat irregular but less so than in preceding species; front shining, widely impunctate (a few punctures posteriorly and laterally); (this species characterized also by coarse punctation of proepisterna and of elytral striae) (p. 29) ..... *siccus*

Chlaenius pan n. sp.

Description. Form as in Figure 9, large, rather slender; black, appendages brownish piceous except *c.* outer halves of femora reddish testaceous; rather shining; reticulate microsculpture fine, faint on front, slightly more distinct on pronotum and elytra, *c.* isodiametric except slightly transverse on part of pronotum. *Head* 0.81 and 0.84 width prothorax; eyes rather abruptly prominent; antennae with 3rd segments about ½ longer than 4th segments and plainly but sparsely setulose; mandibles short, moderately arcuate; mentum with deeply emarginate tooth; clypeus subtruncate; labrum slightly emarginate; palpi narrowly truncate at apex in both sexes. *Prothorax* quadrate; width/length 1.11 and 1.09; base/apex 1.16 and 1.11; sides weakly arcuate anteriorly, slightly converging and very broadly weakly sinuate posteriorly, each with seta *c.* ⅕ of length before base, without median-lateral seta; disc with impressed middle line and rounded basal impressions, wrinkled-punctate at base, nearly smooth (sparsely punctulate) elsewhere; posterior pronotal hair fringe present. *Elytra* long, narrowed toward base; width elytra/prothorax 1.67 and 1.75; margins *c.* obliterated at base (inside bases of 4th striae), rounded at humeri, not interrupted posteriorly; intervals rounded-subcostate, each with an irregular row of punctures on each side. *Lower surface* partly irregularly punctulate, but much of abdomen smooth at middle; metepisterna long, with outer edges raised but not channeled. *Inner wings* full. *Legs* slender; tarsi not pubescent above; 5th segments hind tarsi with 4 or 5 strong setae each side below. *Secondary sexual characters* normal; 2nd segments ♂ front tarsi *c.* wide as long (by measurement); ♂ front femur not dentate; aedeagus long, slender, closed above for nearly half its length (Fig. 171). *Measurements*: length *c.* 25–26; width *c.* 9.1 mm.

Types. Holotype ♂ (Bishop Mus.) from Torricelli Mts., Mokai Village, **N-E. N. G.,** 750 m, Jan. 1–23, 1959 (W. W. Brandt); and paratypes as follows. **N-E. N. G.**: 1 ♂, Maprik, Sepik Dist., 1965 (Dept. Agr. Port Moresby). **West N. G.**: 1 ♀ (M.C.Z., Type No. 31,351), Kota Nika, Res. Hollandia, Jan. 9, 1958 (R. T. Simon Thomas); 1 ♀, Tanahmerah, Res. Boven Digoel, Feb. 1958 (R. T. Simon Thomas).

Measured specimens. The ♂ holotype and ♀ paratype from Kota Nika.

Notes. This new species probably represents *Chlaenius femoratus* Dejean of Java, Sumatra, etc. but is narrower (especially the prothorax) and duller than *femoratus* and lacks subapical interruptions of the elytral margins, which are present though weak in my 5 specimens of *femoratus* from Java. I have 1 ♀ of a related undescribed species from Celebes, which partly fills the

geographic gap between *femoratus* and *pan*.

Chlaenius daer n. sp.

Description. Form of *Chlaenius* of *circumdatus* group; slender; greenish black, head green, elytra sometimes with vestige of very narrow yellowish margin at apex, appendages testaceous brown; reticulate microsculpture absent or faint on head and pronotum, deep, fine, isodiametric on elytra. *Head* 0.82 and 0.82 width prothorax; eyes large, prominent; antennae with 3rd segments *c.* ½ longer than 4th, setulose; mandibles moderate; clypeus and labrum subtruncate; surface of head irregularly, not densely punctate; mentum with ± emarginate tooth. *Prothorax* narrow, quadrate-subcordate; width/length 1.11 and 1.16; base/apex 1.04 and 1.09; sides arcuate except broadly usually strongly sinuate posteriorly; margins narrow, each with seta *c.* ⅓ of length before base, without median-lateral seta; disc irregularly punctate, with fine middle line, linear baso-lateral impressions nearer sides than middle but shallower than usual in the group; posterior pronotal hair fringe absent. *Elytra* slightly narrowed anteriorly; width elytra/prothorax 1.63 and 1.66; margins entire at base, obtusely angulate at humeri, not interrupted posteriorly; intervals weakly convex, each with a row of punctures on each side. *Lower surface* including middle of abdomen extensively punctulate and pubescent; metepisterna long, weakly margined externally. *Inner wings* full. *Legs*: tarsi nearly glabrous above; 5th segments hind tarsi with *c.* 4 short setae each side below. *Secondary sexual characters* normal: 2nd segment male front tarsi *c.* 1/10 longer than wide; male femora not dentate; aedeagus open above for much of length. *Measurements*: length *c.* 12–15.5; width 4.4–6.0 mm.

Types. Holotype ♂ (M.C.Z., Type No. 31,352) and 2 paratypes from Nadzab, **N-E. N. G.,** July 1944 (Darlington); and additional paratypes as follows. **Papua**: 18, Kiunga, Fly R., dates in July, Aug. 1957 (W. W. Brandt, Bishop Mus.); 1, Lake Daviumbu, Fly R., Aug. 19–30, 1936 (Archbold Exp., A.M.N.H.); 1, Palmer R. at Black R., July 22–31, 1936 (Archbold Exp., A.M.N.H.); 1, Kokoda, 1200 ft. (366 m), Aug. 1933 (Cheesman). **N-E. N. G.**: 2, Aitape, Aug. 1944 (Darlington); 1, Main R., Sepik, Feb. 1965 (R. Hornabrook). **West N. G.**: 1, Hollandia, July–Sept. 1944 (Darlington); 1, Tanahmerah, Boven Digoel Res., 17 m, April 15, 1955 (L. D. Brongersma, Leiden Mus.); 1, Idenburg R., 400 m, July 15–Sept. 15, 1938 (J. Olthof, Leiden Mus.); 1, Iebele Camp, Snow Mts., 2250 m, Sept. 1938 (Toxopeus).

Measured specimens. The ♂ holotype and 1 ♀ paratype from Kiunga.

Notes. C. daer is the only species of the *Chlaenius circumdatus* group in New Guinea. This group is widely distributed and common in the warmer part of the Old World including Australia. The present new species seems nearest *acroxanthus* Chaudoir (which ranges from the southeastern corner of Asia to the Moluccas—Louwerens 1956, Treubia 23, p. 223) but has baso-lateral pronotal impressions shallower and punctation less coarse. I have used for comparison a series of *acroxanthus* from Java, collected by Thomas Barbour.

Chlaenius ceylanicus Nietner

Nietner 1856, J. Asiatic Soc. Bengal 25, p. 385.
Csiki 1931, Coleop. Cat., Carabidae, Harpalinae 5, p. 932 (*Hololius*) (see for additional references).
nitidulus Dejean (not Schrank) 1826, Species Général Coléop. 2, p. 341.
ornatus Tryon 1890, Second Annual Report Administrator British New Guinea, Appendix 5, p. 109 (*Poecilus*).
Csiki 1931, Coleop. Cat., Carabidae, Harpalinae 5, p. 563 (*?Pocciloidea*).

Description. None required here; see preceding *Key to Species* for recognition characters. Note 2nd segments ♂ front tarsi ¼ (Javan specimen) or ⅓ (Australian specimen) longer than wide (by measurement); length *c.* 11–12.5 mm.

Types. Of *ceylanicus*, from western and southern **Ceylon**; now in Berlin U. Zool.

Mus. and Stettin Town Mus. (*t.* Andrewes). Of *nitidulus*, from "**Indes orientales**"; in Oberthür Coll., Paris Mus. Of *ornatus*, a ♂ from St. Joseph (Angabunga) R. District, **Papua**, collected by A. C. English; present location of type unknown (not seen).

Occurrence in New Guinea. **Papua**: the type of *ornatus*; 1, Rouku, Morehead R., Apr. 1962 (W. W. Brandt, C.S.I.R.O.). **N-E. N. G.**: 5, Kamindibit, Main R., Sepik, Feb. 1965 (R. Hornabrook), on water weeds in swamp. **West N. G.**: 1 ♀, Garian, Lake Jamoer, Dec. 8, 1954 (L. D. Brongersma, Leiden Mus.).

Notes. "*Hololius*" *ceylanicus* ranges from southern **Asia** to eastern **Australia**, and will probably be found on all the intervening islands, although records are still incomplete. I have found it in Australia under cover by backwaters of rivers and in river floods. Nietner says it flies to light in Ceylon.

Chlaenius maculiger Castelnau

Castelnau 1867, Notes on Australian Coleop., p. 62.
Chaudoir 1876, Ann. Mus. Civ. Genoa 8, p. 67.
Sloane 1910, Proc. Linnean Soc. New South Wales 35, pp. 438, 440.
Csiki 1931, Coleop. Cat., Carabidae, Harpalinae 5, p. 961.
nigripes Macleay (not Dejean, not Faldermann) 1886, Proc. Linnean Soc. New South Wales (2) 1, p. 140.
biroi Csiki 1931, Coleop. Cat., Carabidae, Harpalinae 5, p. 948.

Description (for recognition only). Medium sized, depressed; dark, dark-legged, typically 2-maculate but spots sometimes lost; unique in genus in New Guinea in mandibles very short, semicircular; length *c.* 12–14 mm.

Types. Of *maculiger*, from Rockhampton, **Australia**; probably in Genoa Mus. (I did not find it at Melbourne in 1957). Of *nigripes*, from Fly R., **Papua** (implied); may now be in Macleay Mus., Sydney (not seen). Of *biroi*, as for *nigripes* (the name *biroi* was proposed to replace *nigripes* Macleay, which is preoccupied).

Occurrence in New Guinea. Widely distributed and common: 127 specimens from localities including Dobodura and Wau in all 3 political divisions of **New Guinea**; most at low altitudes but reaching at least 1300 and 1500 m at Wau and on the Bismarck Rge.

Notes. Sloane (1910) has established the identity of *nigripes* Macleay (*biroi* Csiki) with *maculiger* Castelnau.

Outside New Guinea, this species is known from **Australia** and **New Britain** (Cape Gloucester, Jan.–Feb. 1944, Darlington). It is apparently related to and probably derived from the same Oriental stock as *Chlaenius tetragonoderus* Chaudoir, which is widely distributed farther west in the Malay Archipelago, to the mainland of Asia. *C. tetragonoderus batjanicus* Louwerens (1956, Treubia 23, p. 234) of the northern Moluccas, which varies in color of legs, may be a transitional form. An apparently undescribed species of the group occurs in the Solomons.

The yellow subapical elytral spots are individually variable in specimens from New Guinea and are absent or nearly absent in some individuals. The variation in spotting apparently occurs throughout New Guinea.

This is, I think, a rain forest species that may occur in ordinary leaf litter rather than in specially wet places, but I have taken too few specimens to be sure.

Chlaenius guttula Chaudoir

Chaudoir 1856, Bull. Soc. Nat. Moscow 29, Part 2, p. 216.
Csiki 1931, Coleop. Cat., Carabidae, Harpalinae 5, p. 957 (see for additional references).
Andrewes 1941, Ann. Mag. Nat. Hist. (11) 7, p. 310 (in key).
Louwerens 1953, Verhandlungen Naturforschenden Gesellschaft Basel 64, p. 313.
csikii Jedlicka 1951, Ann. Mus. National Hungary 1, p. 136 (new synonymy).
astrolabensis Jedlicka 1951, Ann. Mus. National Hungary 1, p. 136 (new synonymy).
immaculata Louwerens 1962, Tijdschrift voor Ent. 105, p. 145 (new synonymy).

Description (for recognition only). Very small; dull dark bluish, with or without a small pale spot on suture near apex (see

following *Notes*); see also preceding *Key to Species*; length *c.* 8 mm.

Types. Of *guttula*, from **Hongkong**; in Oberthür Coll., Paris Mus. Of *csikii* and *astrolabensis*, both from Stephansort, Astrolabe Bay, **N-E. N. G.**; in Hungarian National Mus. Of *immaculata*, from **Amboina**; in Louwerens Coll. (Types not seen.)

Occurrence in New Guinea. **Papua**: 7, Dobodura, Mar.–July 1944 (Darlington); 1, Bisianumu, near Sogeri, 500 m, Mar. 15–20, 1955 (E. O. Wilson, M.C.Z.), in rain forest; 1, Brown R., May 23, 1956 (E. J. Ford, Jr., Bishop Mus.). **N-E. N. G.**: 1, Bulolo, 731 m, Aug. 26, 1956 (E. J. Ford, Jr., Bishop Mus.); 1, Finschhafen (L. Wagner, M.C.Z.). **West N. G.**: 3, Hollandia, Jan., Apr., May 1945 (B. Malkin, U.S.N.M.); 1, Kota Nika, Res. Hollandia, Nov. 29, 1957 (R. T. Simon Thomas, Louwerens Coll.); 1, Maffin Bay, Jan. 1, 1945 (E. S. Ross, California Acad.).

Notes. This species is known from southern **Asia**, **Sumatra**, **Java**, **Bali**, **Celebes**, **Timor** (Louwerens 1953), the **Philippines**, **New Guinea**, and **New Britain** (Cape Gloucester, Darlington, M.C.Z.). It often flies to light.

Although most specimens from New Guinea have a variable (sometimes minute) vestige of a subapical sutural pale spot, several (not all) of those from Dobodura are unspotted.

The characters given by Jedlicka to distinguish *csikii* from *guttula* seem to me to be individual rather than specific, and "aberration" *astrolabensis* Jedlicka and "var." *immaculata* Louwerens are (I think) unnecessary names for unspotted individuals.

Chlaenius amplipennis Chaudoir

Chaudoir 1876, Ann. Mus. Civ. Genoa 8, p. 252.
Csiki 1931, Coleop. Cat., Carabidae, Harpalinae 5, p. 946.
Andrewes 1941, Ann. Mag. Nat. Hist. (11) 7, p. 310.

Description (for recognition only). Medium small; dark, dull; unique among *Chlaenius* of New Guinea in labrum deeply emarginate; length *c.* 12 mm.

Type. A ♂ from **Java**; in Brussels Mus. (not seen).

Occurrence in New Guinea. **N-E. N. G.**: 1 ♂, Bulolo, 2000 ft. (610 m), Mar.–July 1937 (George Rio, Chicago Mus.); 1 ♀, Main R., Sepik, Feb. 1965 (R. Hornabrook).

Notes. Chlaenius amplipennis apparently ranges from **Sumatra** and **Java** to the **Philippines**, **New Guinea**, and the **Solomons** (Guadalcanal Is., 1944, L. N. Jarcho, M.C.Z.). It varies geographically and some of the geographic forms may be recognizable subspecies, but I do not have enough material to decide about this.

Chlaenius flaviguttatus Macleay

Macleay 1825, Annulosa Javanica, p. 14.
Chaudoir 1876, Ann. Mus. Civ. Genoa 8, p. 52.
Csiki 1931, Coleop. Cat., Carabidae, Harpalinae 5, p. 955 (see for synonymy and additional references).
Andrewes 1941, Ann. Mag. Nat. Hist. (11) 7, p. 307 (in key).
Louwerens 1953, Verhandlungen Naturforschenden Gesellschaft Basel 64, p. 311.
guttatus Eschscholtz 1833, Zoologischen Atlas 5, p. 26, pl. 25, fig. 8.
immaculipennis Jedlicka 1951, Ann. Mus. National Hungary 1, p. 134 (new synonymy).

Description (for recognition only). Medium sized, rather slender; dull, dark, elytra 2-maculate or immaculate, legs pale usually with dark knees; most of upper surface closely conspicuously punctate; palpi with apical segments truncate, apices ⅓ or ½ wide as length of segment; see also *Key to Species*; length *c.* 11–14.5 mm.

Types. Of *flaviguttatus*, from **Java**; in British Mus. (seen). Of *guttatus*, **Manil(l)a**; Moscow U. Zool. Mus. (not seen). Of *immaculipennis*, **New Guinea**; in Jedlicka Coll. (not seen).

Occurrence in New Guinea. Widely distributed on New Guinea (including Dobodura and Wau), and reaching Biak and (in the Admiralties) Manus Is.: 283 specimens, most at low altitudes but reaching at least 1300 and 1500 m in places in the mountains.

Notes. This common *Chlaenius* is known from **Sumatra**, **Java**, etc. to **New Guinea** and **Australia**, east to the **Philippines**, **New Britain**, **New Ireland**, **Solomons**, **New Hebrides**, **Fiji**, **Samoa**, and **New Caledonia**.

Markings vary *individually* in the series from New Guinea. Each elytron may have a conspicuous irregular subapical pale mark, or fragments of such a mark, or no mark at all, and the variation occurs in all parts of New Guinea from which series have been seen. Unmarked individuals are "aberration" *immaculipennis* Jedlicka, which I think is not worth distinguishing.

This species occurs in a variety of wet places, often in more or less open country.

Chlaenius bimaculatus pongraczi Jedlicka

Jedlicka 1951, Ann. Mus. National Hungary 1, p. 136.

Description. Generally similar to typical *bimaculatus* Dejean in technical characters (see preceding *Key* and also Andrewes' key to Javan *Chlaenius*, 1941, Ann. Mag. Nat. Hist. (11) 7, p. 307), but differing somewhat in color and especially in punctation. Color bluish black, legs testaceous (not bicolored), antennae and mouthparts reddish brown. Punctation of head and pronotum reduced but variable: head with or almost without punctulation (most distinct posteriorly); pronotum coarsely punctate only basally, extensively smooth or in part finely punctulate elsewhere; length *c.* 12–14 mm.

Type. From **New Guinea**; in Hungarian National Mus. (not seen).

Occurrence in New Guinea. **Papua**: 9, Dobodura, Mar.–July 1944 (Darlington); 7, Mt. Lamington, 1300–1500 ft. (*c.* 400–450 m), (C. T. McNamara, S. Australian Mus.); 2, Kokoda, 1200 ft. (366 m), May & Aug. 1933 (Cheesman); 1, Daradae, near Javarere, Musgrove R., Oct. 4, 1958 (Gressitt). **N-E. N. G.**: 3, Sattelberg (British Mus.); 1, Wareo, Finschhafen (Rev. L. Wagner, S. Australian Mus.); 1, Gewak, Salawaket Rge., 1530 m, Sept. 7, 1956 (E. J. Ford, Jr., Bishop Mus.); 1, Sepik, Maprik area, 160 m, Aug. 26, 1957 (D. Elmo Hardy, Bishop Mus.). **West N. G.**: 1, Hollandia, Jan. 1933 (A.M.N.H.); 1, Waris S. of Hollandia, 450–500 m, July 24–31, 1959 (T. C. Maa, Bishop Mus.); 2, Ifar, Cyclops Mts., 300–500 m, June 23–25, Sept. 9, 1962 (Sedlacek); 1, Guega, W. of Swart Vy., 1200 m, Nov. 14, 1958 (Gressitt); 1, Bodem, 11 km SE. of Oerbefareh, 100 m, July 7–17, 1959 (T. C. Maa, Bishop Mus.).

Notes. Chlaenius bimaculatus Dejean (or the group of closely related species that goes under this name) ranges from **SE. Asia** to the **Philippines** and **New Guinea** (not Australia). I have ample comparative material from a number of localities from SE. Asia to Amboina. Geographic variation is obvious. The New Guinean form varies also *individually* in marking: most individuals have a conspicuous pale spot before apex of each elytron, but the spot varies in size and is almost absent in 2 of the Sattelberg specimens.

My Dobodura specimens were taken in a grassy bank beside a small river.

Chlaenius olthofi n. sp.

Description. Form (Fig. 10) of *Chlaenius bimaculatus* Dejean, slender; head and pronotum shining green or greenish black; elytra duller, purplish black, with very fine *c.* isodiametric microsculpture; appendages rufous. *Head* 0.72 and 0.76 width prothorax; eyes large, genae short; antennae with 3rd segments *c.* equal to 4th and sparsely setulose; mandibles average; clypeus and labrum subtruncate or weakly emarginate; front with *c.* punctiform anterior impressions, otherwise almost impunctate (a few punctules posteriorly); mentum with *c.* entire tooth; palpi narrowly truncate at apex. *Prothorax* subquadrate, widest at or slightly behind middle; width/length 1.16 and 1.13; base/apex 1.17 and 1.10; apex not margined except vaguely at sides; sides broadly rounded, not or at most faintly sinuate before obtuse but well defined, slightly blunted posterior angles; posterior-

lateral setae *c.* 1/10 of prothoracic length before base, median-lateral setae absent; disc with impressed middle line, sublinear baso-lateral impressions; surface extensively smooth but with a few punctures mostly near base, sides, and along middle; posterior pronotal hair fringe present. *Elytra*: width elytra/prothorax 1.44 and 1.45; margins entire at base, rounded at humeri, with subapical interruptions; striae moderately impressed, vaguely punctulate; intervals slightly convex, moderately closely punctate. *Lower surface* shining; proepisterna almost impunctate; some punctures on metepisterna including epimera and on base of abdomen at sides, but much of abdomen smooth or nearly so; metepisterna long, margined externally, margin obsolete anteriorly. *Inner wings* full. *Legs*: tarsi *c.* glabrous above; 5th segments hind tarsi with *c.* 7 setae each side below. *Secondary sexual characters*: ♂ front tarsi with 2nd segments *c.* wide as long; ♂ front tibiae with small tooth below near base; ♂ with usually 1, ♀ 2 or 3 (unsymmetric in the single ♀) setae each side last ventral segment. Aedeagus slender, open above for much of length. *Measurements*: length *c.* 13–14; width *c.* 4.5–5.0 mm.

Types. Holotype ♂ (Leiden Mus.) and 1 ♂ paratype (M.C.Z., Type No. 31,353) from Bernhard Camp, **West N. G.,** 50 m, July–Sept. 1938 (J. Olthof); 1 ♀ paratype, same locality, Apr. 12, 1939 (Toxopeus); 1 ♂ paratype, Oro Bay, **Papua**, July 12, 1944 (A. H. Mallery, Bishop Mus.).

Measured specimens. The ♂ holotype and ♀ paratype.

Notes. This seems to be a distinct species of the *bimaculatus* group, occurring within the geographic range of *bimaculatus* subspecies *pongraczi*. *C. olthofi* may be a product of an early invasion of a *bimaculatus*-like stock, *pongraczi* of a later one.

Chlaenius occultus Sloane

Sloane 1907, Deutsche Ent. Zeitschrift for 1907, p. 467.

Description (for recognition only). A medium-sized *Chlaenius* with subcordate prothorax; blue-black, sometimes in part greenish, legs reddish testaceous, antennae and mouthparts reddish brown; rather shining, reticulate microsculpture absent or nearly so on head and pronotum, visible on elytra especially of female, fine, irregularly isodiametric; see also *Key to Species of Chlaenius of New Guinea*; length *c.* 14–17 mm.

Type. From Herbertshöhe, **New Britain**, "returned to Dr. Horn for Bennigsen's collection" (not seen).

Occurrence in New Guinea. **Papua**: 7, Dobodura, Mar.–July 1944 (Darlington); 4, Kokoda, 1200 ft. (366 m), May, Aug. 1933 (Cheesman); 1, Laloki, 1909 (F. Muir, Hawaiian Sugar Planters Association); 5, Mt. Lamington, 1300–1500 ft. (*c.* 400–450 m) (C. T. McNamara, S. Australian Mus.); 1, Peria Ck., Kwagira R., 50 m, "No. 7," Aug. 14–Sept. 6, 1953 (Geoffrey M. Tate, A.M.N.H.). **N-E. N. G.**: 30, vic. Nadzab, July 1944 (Darlington); 1, Busu R., E. of Lae, 100 m, Sept. 14, 1955 (Gressitt); 2, Wau, 1100, 1200 m, Oct. 30, 1961, July 28–29, 1963 (Sedlacek). **West N. G.**: 5, Hollandia, Jan., Apr., May 1945 (B. Malkin, U.S.N.M.); 1, Humboldt Bay Dist., 1937 (W. Stüber, British Mus.); 1, Tanahmerah, Res. Boven Digoel, Apr. 24, 1957 (R. T. Simon Thomas, Leiden Mus.).

Notes. I have identified this species from Sloane's description: the size, cordate prothorax, and rounded humeral margins are (together) diagnostic in the region in question; other details agree well enough; and I have seen a specimen from New Britain (near Rabaul, Feb. 1929, Pemberton collector, in Coll. Hawaiian Sugar Planters Association).

This species occurs in **New Britain** (the type, and the specimen from near Rabaul referred to above) and the **Solomons** (Guadalcanal; Bougainville) as well as **eastern and central New Guinea**. I have been unable to determine its relationship to other species of *Chlaenius*. It is found under stones on the banks of rivers.

Chlaenius hamifer malcheri Van Emden

Van Emden 1937, Stettiner Ent. Zeitung 98, pp. 35, 37.

Description (for recognition only). Medium small, moderately broad; usually very dark with or without slight metallic tinge, usually without spots but latter sometimes partly developed (see *Notes* below); see also *Key to Species*; length *c.* 11–12 mm.

Type. From Pauru, New Georgia, **Solomon Islands** (Fr. Malcher); in Van Emden Coll., British Mus. (seen).

Occurrence in New Guinea. **Papua**: 13, Dobodura, Mar.–July 1944 (Darlington); 1, Oro Bay, July 12, 1944 (A. H. Mallery, Bishop Mus.); 1, Kokoda, 1200 ft. (366 m), Aug. 1933 (Cheesman); 1, Port Moresby, Konedobu, Apr. 20, 1958 (J. J. H. Szent-Ivany, Dept. Agr. Port Moresby), at light; 1, Popondetta, Aug. 11, 1962 (A. Catley, Dept. Agr. Port Moresby), at light; 1, Mt. Lamington, 1300–1500 ft. (*c.* 400–450 m) (C. T. McNamara, S. Australian Mus.); 2, Rouku, Morehead R., Apr. 1962 (W. W. Brandt, C.S.I.R.O.); 1, Rossel Is. (S.E. Papua), Oct. 1963 (W. W. Brandt, C.S.I. R.O.). **N-E. N. G.**: 2, "No. 2, Oomsis," 22 mi. W. of Lae on Lae-Bulolo Road, 100 m, Apr. 26, 1959 (L. J. Brass, A.M.N.H.); 2, Wau, Morobe Dist., 1200 m, Dec. 6, 1961, Sept. 15–30, 1962 (Sedlacek); 1, Bulolo "G. T.," (Sedlaceks); 1, 16 km W. of Mumeng, 3000–5000 m, May 1962 (Sedlacek); 1, Okapa, July 12, 1964 (R. Hornabrook); 1, lower Busu R., Huon Pen., May 12, 1955 (E. O. Wilson, M.C.Z.). **West N. G.**: 1, Hollandia, May 1945 (B. Malkin, U.S. N.M.); 1, Maffin Bay, June 1944 (E. S. Ross, California Acad.); 1, Wissel Lakes, Tage Lake, 1760 m, Aug. 4, 1955 (Gressitt); 1, Wissel Lakes, Enarotadi, 1900–2000 m, July 2–11, 1962 (N. Wilson, Bishop Mus.).

Notes. This species belongs to a difficult group of *Chlaenius* that extends from S. Asia to NE. Australia. The group includes *hamatus* Dejean as well as *hamifer* Chaudoir. I am not sure whether these two species really are different, or with which of them *malcheri* should go. My treatment of it as a geographic form of *hamifer* is tentative. The range of *hamifer* is from S. Asia to Australia.

Apparently only one form of the *hamifer-hamatus* group occurs in New Guinea. It is very dark and usually unmarked, but 2 examples from Dobodura show the posterior part of a pale "comma" on the apex of each elytron, and the 1 specimen from Port Moresby, the 2 from Rouku, and the 1 from Hollandia have the "commas" complete but narrow. *Chlaenius insulanus* Louwerens (1956, Treubia, 23, p. 234) of the northern Moluccas is another dark, unmarked form of the *hamifer-hamatus* group, but is smaller and narrower than *malcheri*.

C. h. malcheri occurs under cover often in somewhat drier places than most other *Chlaenius* except the following (*siccus*).

Chlaenius siccus n. sp.

Description. Form *c.* average in genus; rather shining black, sometimes with slight greenish or bluish reflections, appendages rufous; reticulate microsculpture absent on head and pronotum, fine and *c.* isodiametric on elytra. *Head* 0.68 and 0.67 width prothorax; eyes large, genae short; antennae with 3rd segments *c.* equal 4th and scarcely setulose; mandibles average, rather short, moderately arcuate; labrum and clypeus subtruncate; front almost smooth at middle, punctate at sides and posteriorly, with slight frontal impressions; mentum with blunt usually vaguely emarginate tooth; palpi slender, narrowly subtruncate at apex. *Prothorax* subquadrate but rather strongly narrowed anteriorly; width/length 1.28 and 1.28; base/apex 1.33 and 1.31; sides weakly arcuate for most of length, *c.* straight and somewhat converging posteriorly; posterior angles obtuse, narrowly rounded; margins narrow anteriorly, wider posteriorly, each with posterior-lateral setae just before base and (at least in some individuals) median-lateral setae just before middle; disc irregularly longitudinally impressed each side

c. midway between middle and side, with whole surface rather closely but somewhat irregularly, coarsely punctate; posterior pronotal hair fringe present. *Elytra* not narrowed anteriorly; width elytra/prothorax 1.29 and 1.36; margins entire at base, arcuate at humeri, interrupted subapically; striae rather coarsely punctate, intervals slightly convex, irregularly punctulate. *Lower surface*: proepisterna coarsely punctate at least in part, mesepisterna partly punctate or almost impunctate, sides of metasterna punctate, abdomen punctulate at sides and across base but extensively smooth or nearly so at middle; metepisterna long, strongly margined (grooved) externally. *Inner wings* full. *Legs* without obvious unusual characters; tarsi *c.* glabrous above; 5th segments hind tarsi with *c.* 4 setae each side below. *Secondary sexual characters* normal; ♂ front tarsi dilated, 2nd segment at least as wide as long; ♂ front tibiae not toothed; ♂ with 1, ♀ 2 setae each side last ventral segment. *Measurements*: length *c.* 11.5–13.5; width 4.1–4.8 mm.

Types. Holotype ♂ (M.C.Z., Type No. 31,354) and 14 paratypes from Dobodura, **Papua**, Mar.–July 1944 (Darlington); and additional paratypes as follows. **Papua**: 2, Mt. Lamington, 1300–1500 ft. (*c.* 400–450 m) (C. T. McNamara, S. Australian Mus.). **N-E. N. G.**: 1, Aitape, Aug.–Sept. 1936 (Cheesman); 4, Swart Vy., Karubaka, 1450, 1500, 1550 m, Sept. 8, 16, 22, 1958 (Gressitt), some taken in light trap; 8, Wau, Morobe Dist., 1200 m, dates in Jan., Feb., Mar., Aug., 1962–1963 (Sedlacek); 1, Sum-Sum, near Bulolo, Morobe Dist., Feb. 7–11, 1966 (Rhonda M. Stevens, Dept. Agr. Port Moresby); 7, Minj, W. Highlands, 5200 ft. (*c.* 1600 m), Mar. 25, May 20, 1960 (J. H. Barrett, Dept. Agr. Port Moresby). **West N. G.**: 1, Hollandia, May 1945 (B. Malkin, U.S.N.M.); 1, Kota Nika, Res. Hollandia, Feb. 23, 1956 (R. T. Simon Thomas, Louwerens Coll.); 4, Ifar, Cyclops Mts., 300–500 m, June 23–25, 1962 (Sedlacek); 1, same locality, 400–800 m, Sept. 9, 1962 (Sedlacek); 2, "G. den Hoed, Ifar," Dec. 1957 (Louwerens Coll.); 1, Kebar Vy., W. of Manokwari, Vogelkop, 550 m, Jan. 4–31, 1962 (S. & L. Quate, Bishop Mus.).

Measured specimens. The ♂ holotype and 1 ♀ paratype from Dobodura.

Notes. In Andrewes' (1941, see reference under genus) key to the *Chlaenius* of Java, this runs to *leucops* Wiedemann, of which I have specimens from India, Java, and Luzon, but the present new species is narrower, paler-legged, and more shining than *leucops*, with somewhat different sculpture: e.g., the punctation of the pronotum is coarser and more irregular than in *leucops*. *C. siccus* is closer to, and may prove to be a geographic representative of, *ophonoides* Fairmaire of Australia (recorded also from New Caledonia and New Hebrides). However, *siccus* is slightly smaller and much darker than *ophonoides*, being black without or with only faint metallic tinge while *ophonoides* is always plainly greenish black.

In habits, this species resembles the preceding one (*hamifer malcheri*) and often occurs with it, under cover on comparatively dry ground in more or less open places.

Tribe OODINI

Csiki 1931, Coleop. Cat., Carabidae, Harpalinae 5, p. 1000 (see for synonymy and additional references).

Ooditae Auct. including Jeannel 1949, Coléop. Carabiques de la Région Malgache, Part 3, p. 828.

The members of this tribe are oval, *Amara*- or even dytiscid-like, and are black or metallic, usually unmarked. Their generic classification is unsatisfactory (see below, and see *Notes* under *Anatrichis* and *Oodes laevissimus*). However, the 13 species of the tribe known from New Guinea obviously include no striking endemic genera and, although diverse, they are less so than the oodines of the Oriental Region or Australia. The Oriental *Systolocranius, Holcocoleus, Simous* (see under *Oodes laevissimus*), etc., and the Australian *Coptocarpus* do not reach New Guinea.

The presence or absence of a basal elytral margin is a useful key character in this tribe but must be determined with care. The basal margin is a fine, sharply marked line, impressed or formed by a slight elevation of the elytral surface in front of the margin, and usually ending inwardly opposite the bases of the 3rd striae or 3rd intervals. It is distinct from the basal depression of the elytra that fits under the base of the pronotum. It is best examined under diffused light, for a sharply focused spotlight makes reflections that simulate a margin where none is present.

Presence or absence of a small seta-bearing puncture on the posterior edge of the pronotum on each side near the basal angle is another useful key character that must be determined with care. The setae are sometimes very small and weak and easily broken off. The punctures may then be hard to detect even in clean specimens and undetectable in dirty ones. Sometimes these setae and punctures vary within single species (see *Oodes siamensis*).

Clean specimens of *Anatrichis pusilla*, *Oodes exiguus*, and *O. piceus* can be seen to have a small anterior puncture over each eye, with or without a small, weak seta. These punctures are lacking in all other New Guinean Oodini. This suggests an actual relationship among the 3 species named, which is supported by the arrangement of labral setae and by a similarity of body form, and this in turn suggests that the conventional distinction between *Anatrichis* and *Oodes* is unnatural. However, I cannot recharacterize these 2 widely distributed genera on the basis of the few species that occur in New Guinea.

Most oodines are aquatic or subaquatic, living in vegetation or among dead leaves in or close to standing water, but *O. laevissimus* Chaudoir and probably also the 2 related species described below (i.e., the *laevissimus* group) live in leaf litter on the floor of rain forest. This is the habitat of some *Coptocarpus* in Australia and of certain other oodines elsewhere. State of wings is correlated with habitat. The wings are fully developed in all known New Guinean Oodini except the *Oodes laevissimus* group, in which the wings are apparently atrophying as the group leaves subaquatic habitats and invades terrestrial leaf litter. At the same time the group is apparently beginning to evolve local flightless species in different places in New Guinea.

KEY TO GENERA OF OODINI OF NEW GUINEA

1. Size small (*c.* 5 mm); clypeus without seta-bearing punctures; ♂ front tarsi only slightly dilated (p. 31) ..... *Anatrichis*
– Size usually larger; *if* size small, clypeus with seta-bearing puncture on each side and ♂ front tarsi wider (p. 32) ..... *Oodes*

Genus *ANATRICHIS* Leconte

Leconte 1853, Trans. American Philosophical Soc. 10, p. 391.
Chaudoir 1882, Ann. Soc. Ent. France (6) 2, p. 318.
Sloane 1910, Proc. Linnean Soc. New South Wales 35, pp. 442, 443 (the Australian species).
Csiki 1931, Coleop. Cat., Carabidae, Harpalinae 5, p. 1003 (see for synonymy and additional references).

Diagnosis. Very small Oodini; clypeus and posterior margin of pronotum without seta-bearing punctures; labrum with clump of 4 setae at middle and 1 separate seta each side; ♂ front tarsi typically only slightly dilated, but variable (see *Notes* below).

Description. None required here.

Type species. Oodes minutus Dejean, of North America.

Generic distribution. **India** and **Burma** to **Australia**; tropical and warm temperate **America**.

Notes. The characters and limits of this genus are doubtful, as suggested in discussion under the tribe (above).

Authorities disagree about the ♂ front tarsi of *Anatrichis*. Leconte says 4 segments are slightly dilated and spongiose (with dense squamae) below. Chaudoir says 3 segments are thus modified. And Sloane says only 2 segments have squamae. In fact, different species differ in this respect, and minor variations of ♂ tarsi may even occur

within single species (see *Notes* under *A. pusilla*, below).

Anatrichis pusilla Sloane

Sloane 1910, Proc. Linnean Soc. New South Wales 35, p. 443.

Description (diagnostic characters only). Small, narrow; pronotum usually with an almost punctiform impression each side near base, but these impressions variable and sometimes almost absent; elytra 7-striate, striae punctulate; ♂ tarsi slightly dilated, with 2 or 3 segments squamulose below (see following *Notes*); other characters given in preceding *Key to Genera*; length *c.* 5 mm.

Types. Described from 2 specimens taken by Sloane near Kuranda, North Queensland, **Australia**, June 1906. I here designate as lectotype the single specimen now in the Sloane Collection at Canberra. It is labeled "Kuranda, Q., T.G.S., 6.06" and "Anatrichis pusilla Sl., Id. by T. G. Sloane" (seen).

Occurrence in New Guinea. **Papua**: 5, Dobodura, Mar.–July 1944 (Darlington); 9, Oro Bay, Dec. 1943–Jan. 1944 (Darlington); 3, Lake Daviumbu, Fly R., Sept. 11–20 and 21–30, 1936 (Archbold Exp., A.M.N.H.); 1, Modewa, Modewa Bay, 0–50 m, "No. 17," Dec. 14, 1956 (L. J. Brass, Fifth Archbold Exp., A.M.N.H.). **N-E. N. G.**: 1, Aitape, Aug. 1944 (Darlington). **West N. G.**: 24, Hollandia, July–Sept. 1944 (Darlington); 2, Sarmi, W. of Hollandia, July 20–23, 1959 (T. C. Maa, Bishop Mus.); 3, Maffin Bay, Aug. 1944 (Darlington).

Notes. I have a series of *pusilla* from North Queensland, Australia: from Cairns (near the type locality), south to Cardwell, and north to Silver Plains halfway up the Cape York peninsula. Specimens from New Guinea match Australian ones well.

A. pusilla is similar to and may represent *Anatrichis indica* Chaudoir of India, and I have a related species from Leyte in the Philippines.

The narrowly dilated ♂ front tarsi seem to have either 2 or 3 segments squamulose. I cannot determine whether this is primarily individual variation, or whether the squamae are worn off the 3rd segments in some individuals, or whether the squamae are sometimes pressed against the soles of the 3rd segments and therefore almost undetectable.

Genus *OODES* Bonelli

Bonelli 1810, Observations Ent. 1, table synoptique, Mem. Acad. Sci. Turin 18, pp. 21–78.

Sloane 1910, Proc. Linnean Soc. New South Wales 35, p. 442 (Australian species).

Csiki 1931, Coleop. Cat., Carabidae, Harpalinae 5, p. 1006 (see for synonymy and additional references).

Andrewes 1940, Proc. R. Ent. Soc. London (B) 9, pp. 203 ff. (key to species of India, Burma, etc.).

Jeannel 1942, Faune de France, Coléop. Carabiques, Part 2, p. 980.

Diagnosis. No satisfactory one available. For practical purposes all New Guinean members of the tribe except *Anatrichis pusilla* are assigned to *Oodes*.

Description. None required here.

Type species. Carabus helopioides Fabricius, of Europe.

Generic distribution. Most of the warmer parts of the **world**, but few or none in South America.

Notes. For comments on classification, habitats, and state of wings see tribe Oodini, above.

Key to Species of *Oodes* of New Guinea

1. Labrum with compact clump of 4 (or fewer) setae at middle and 1 separate seta each side 2
– Labrum with 6 or 4 separate setae (if 4, 2 additional minute setae usually present close together near middle) 3
2. Elytra with 7th striae almost obliterated; length *c.* 8 mm (p. 33) ..... *piceus*
– Elytra with 7th striae well impressed; length *c.* 5 mm (p. 33) ..... *exiguus*
3. Clypeus without seta-bearing punctures 4
– Clypeus with seta-bearing puncture each side 7
4. Prothorax without basal setae or punctures (p. 33) ..... *nil*
– Prothorax with seta or small puncture on or near posterior edge each side (*laevissimus* group) 5

5. Elytra with basal margin sharply defined (see under tribe Oodini); inner wings full or nearly so (p. 34) ..... *laevissimus*
– Elytra with basal margin obsolete; inner wings vestigial 6
6. Elytral striae distinctly impressed; posterior pronotal punctures on dorsal surface at base (West N. G.) (p. 34) ..... *rossi*
– Elytral striae reduced to fine superficial lines; posterior pronotal punctures on basal edge of pronotum (N-E. N. G.) (p. 35) ..... *wilsoni*
7. Clypeus margined anteriorly, with setae almost in the angles (p. 36) ..... *siamensis vulsus*
– Clypeus not margined, with setae behind the angles 8
8. Prothorax with seta or small puncture each side on posterior edge 9
– Prothorax without such setae or punctures; (form stout, convex; ♂ middle tibiae bent near base; length *c.* 13.5–15.0 mm) (p. 36) ..... *denisonensis*
9. Elytra with basal margin sharply defined (see under tribe Oodini) (p. 36) ..... *siccus*
– Elytra with basal margin obsolete 10
10. Metepisterna sparsely, vaguely, or not punctate (p. 37) ..... *par*
– Metepisterna closely punctate 11
11. Form average, prothoracic width/length *c.* 1.65 (p. 37) ..... *cribristernis*
– Form slender, prothoracic width/length 1.44–1.49 (p. 38) ..... *longior*

Oodes *piceus* Nietner

Nietner 1856, J. Asiatic Soc. Bengal 25, p. 526.
Andrewes 1930, Cat. Indian Insects, Part 18, Carabidae, p. 238.
——— 1940, Proc. R. Ent. Soc. London (B) 9, p. 205 (in key).
Csiki 1931, Coleop. Cat., Carabidae, Harpalinae 5, p. 1010.

Description (for recognition only). A narrowly oval, convex *Oodes* with elytra 6-striate (7th striae absent or faint) and other technical characters given by Andrewes (1940); length *c.* 8 mm. See also preceding *Key* and following *Notes*.

Type. From Colombo, **Ceylon**; in Stettin Mus. (not seen).

Occurrence in New Guinea. **Papua**: 1, Oro Bay, Dec. 1943–Jan. 1944 (Darlington). **West N. G.**: 1, Hollandia, 250 ft., May 1945 (H. Hoogstraal, Chicago Mus.), in rain forest.

Notes. At the British Museum in 1947–1948, I compared *Oodes piceus* with *westermanni* Laferte as identified by Andrewes, and could find no significant external differences except in form of ♂ front tarsi, which are wider in *westermanni*. The New Guinean specimens are ♀ ♀, so their assignment to *piceus* is tentative. *Oodes piceus* has been recorded from **SE. Asia**, **Sumatra**, **Java**, the **Philippines**, and **Celebes**. *O. westermanni* occurs in the same general area.

Oodes *exiguus* Andrewes

Andrewes 1933, Ent. Monthly Mag. 69, p. 56.
pygmaeus Andrewes 1936, Treubia 15, p. 218 (name used in error for *exiguus*).

Description (for recognition only). Very small, size of *Anatrichis pusilla* but differing as noted below; see also preceding *Key to Species*; length *c.* 5 mm.

Types. A ♂ from **Sumatra**, in Deutsches Entomologisches Mus. (not seen); a ♀ "cotype" in Andrewes Coll., British Mus. (seen).

Occurrence in New Guinea. **Papua**: 71, Dobodura, Mar.–July 1944 (Darlington); 12, Oro Bay, Dec. 1943–Jan. 1944 (Darlington). **West N. G.**: 23, Hollandia, July–Sept. 1944 (Darlington); 6, Maffin Bay, Aug. 1944 (Darlington).

Notes. The known range of this species is now **Sumatra** (the types), Leyte Is. in the **Philippines** (Darlington, M.C.Z.), Morotai Is. in the **Moluccas** (Darlington, M.C.Z.), and **New Guinea**. It is not known in Australia.

This small oodine differs from *Anatrichis pusilla* as follows: form wider; only 1 seta over each eye (2 in *pusilla*); mandibles longer, straighter; clypeus with seta-bearing punctures; elytra with striae not punctulate; ♂ front tarsi wider (2nd segments *c.* long as wide), with 3 segments squamulose below. Both *A. pusilla* and *O. exiguus* have elytra with humeri dentate and 3rd intervals 2-punctate.

Oodes *nil* n. sp.

Description. Form (Fig. 11) average, moderately convex; black, appendages slightly

rufescent; moderately shining, whole upper surface with microsculpture of fine *c.* isodiametric meshes and also fine punctulation. *Head* 0.50 and 0.51 width prothorax; labrum 6-setose, the 2 middle setae small and close together; clypeus not margined, without setae; only 1 (posterior) seta over each eye; front irregular but scarcely impressed; mentum tooth triangular, not distinctly emarginate. *Prothorax*: width/length 1.67 and 1.62; base/apex 1.75 and 1.80; disc with fine middle line but transverse and basolateral impressions slight and poorly defined; posterior edge without setae. *Elytra*: width elytra/prothorax 1.05 and 1.06; basal margin present; humeri not dentate; striae lightly impressed, finely punctate; intervals nearly flat, 8th wide at base, 3rd 2-punctate. *Inner wings* full. *Lower surface*: prosternal process weakly or not margined between coxae; sides of body including metepisterna extensively and closely punctate. *Secondary sexual characters*: ♀ with 1 seta each side last ventral segment; ♂ unknown. *Measurements* (types); length 10.5–11; width 3.3–3.4 mm.

Types. Holotype ♀ (M.C.Z., Type No. 31,555) from Dobodura, **Papua**, Mar.–July 1944 (Darlington); 1 ♀ paratype from Oro Bay (near Dobodura), Dec. 1943–Jan. 1944 (Darlington).

Additional material. One ♀, Maffin Bay, **West N. G.,** June 1944 (E. S. Ross, California Acad.).

Measured specimens. The holotype and paratype.

Notes. For distinguishing characters of this species see preceding *Key to Species*, and *Notes* under *Oodes siccus* (p. 37). The specimen from Maffin Bay is larger than the types (length *c.* 12.5 mm) but has the same technical characters.

Oodes *laevissimus* Chaudoir

Chaudoir 1882, Ann. Soc. Ent. France (6) 2, p. 361.

Andrewes 1924, Ann. Mag. Nat. Hist. (9) 14, p. 588 (*Simous*).

Description (for recognition only). Form parallel, depressed; strongly shining; elytra lightly striate; for technical characters see preceding *Key to Species*; length *c.* 11.5–12.5 mm.

Types. From Fly R., presumably **Papua**, collected by D'Albertis; the actual type (*t.* Andrewes) in Oberthür Coll., Paris Mus. (not seen).

Occurrence in New Guinea. **Papua**: Fly R. (the types); 22, Dobodura, Mar.–July 1944 (Darlington); 1, Kokoda, 1200 ft. (366 m), Aug. 1933 (Cheesman). **N-E. N. G.**: 19, Aitape, Aug. 1944 (Darlington); 7, lower Busu R., Huon Pen., Apr. 4, May 13, 1955 (E. O. Wilson, M.C.Z.); 2, Erima, Astrolabe Bay, 1897 (Biró); 1, Sattelberg (British Mus.); 2, Wareo, Finschhafen (Rev. L. Wagner, S. Australian Mus.).

Notes. This distinct species is probably confined to New Guinea, perhaps to the eastern and central part of the island. Andrewes referred it to the genus or subgenus *Simous*, but I think this was a mistake. *Simous* seems to be a natural group of about 9 known species confined to the Oriental Region including Sumatra, Java, and Borneo, and characterized by a very short, broad labrum and a broad, emarginate mentum tooth. *Oodes laevissimus* has the labrum narrower, the mentum tooth narrower and scarcely emarginate.

The wings in some individuals of this species look fully developed and fit for flight but in others they appear slightly reduced (but still nearly full) and unfit for flight. It is doubtful if any individuals really fly. I have seen none from light traps.

Although all other New Guinean Oodini that I have collected are aquatic or semiaquatic, this one is not associated with open water but lives among dead leaves on the floor of rain forest. This is probably also the habitat of the two related forms described below.

Oodes *rossi* n. sp.

Description. Form as in Figure 12, *c.* as *laevissimus*, subparallel, rather depressed;

black; tarsi, antennae, and mouthparts more brownish; moderately shining, entire upper surface with very fine *c.* isodiametric microsculpture but without or with only indistinct punctulation. *Head* 0.52 width prothorax; labrum 6-setose; clypeus not margined, without setae; 1 (posterior) seta over each eye; frontal impressions distinct but poorly defined; mentum with moderately broad *c.* truncate tooth. *Prothorax*: width/length 1.66; base/apex 1.69; disc flattened especially posteriorly, with middle line (and superficial irregularities) but no other distinct impressions; 1 well impressed seta-bearing puncture on each side on dorsal surface just before basal edge. *Elytra*: width elytra/prothorax 1.09; basal margin obsolete; humeri not dentate; striae slightly impressed, faintly punctulate; intervals nearly flat, 8th wide at base, 3rd with 2 inconspicuous dorsal punctures. *Inner wings* atrophied, reduced to narrow strips *c.* ⅛ long as elytra. *Lower surface*: prosternal process not margined between coxae; metepisterna (and rest of lower surface) virtually impunctate. *Secondary sexual characters*: ♂ front tarsi moderately dilated (2nd segments slightly wider than long), 3 segments densely squamulose below; ♂ with 1 seta each side last ventral segment; ♀ unknown. *Measurements*: length 14; width 5.9 mm.

Type. Holotype ♂ (California Acad.) from Maffin Bay, **West N. G.,** June 14, 1944 (E. S. Ross); the type is unique.

Notes. This species has probably differentiated locally, from *laevissimus*-like stock, by atrophy of the wings, obliteration of the basal elytral margin, and other small changes.

Oodes *wilsoni* n. sp.

Description. Form (Fig. 13) and characters of the preceding species (*rossi*) except as follows. *Head* 0.51 width prothorax. *Prothorax*: width/length 1.72; base/apex 1.78; basal seta-bearing punctures on (not before) basal edge of pronotum. *Elytra*: width elytra/prothorax 1.06; striae very fine, superficial. *Inner wings* reduced to vestiges *c.* ¼ long as elytra. *Secondary sexual characters*: ♂ unknown; ♀ with 1 seta each side last ventral segment. *Measurements*: length 14; width 5.9 mm.

Type. Holotype ♀ (M.C.Z., Type No. 31,556) from Ebabaang, Mongi watershed, Huon Pen., **N-E. N. G.,** 1300–1400 m, Apr. 16–18, 1955 (E. O. Wilson); the type is unique.

Notes. This is apparently another localized flightless species derived from *laevissimus*-like stock.

(Oodes *siamensis* Chaudoir)

Chaudoir 1882, Ann. Soc. Ent. France (6) 2, p. 358.
Csiki 1931, Coleop. Cat., Carabidae, Harpalinae 5, p. 1011.
issus Andrewes 1931, J. Federated Malay Mus. 16, pp. 434, 444, fig. 4 (new synonymy).
alesi Jedlicka 1936, Acta Soc. Ent. Czechoslovakia 33, p. 66 (new synonymy).

Description (for recognition only). Form average, depressed; black; clypeus margined, with setae in angles; see *siamensis vulsus* in preceding *Key to Species of Oodes,* but note basal seta-bearing punctures of pronotum usually present in typical *siamensis* (see *Notes* below); length *c.* 8–9 mm.

Types. Of *siamensis*, from Bangkok, **Thailand**; in Oberthür Coll., Paris Mus. (not seen). Of *issus*, from Brunei, **Borneo**; in Andrewes Coll., British Mus. (seen). Of *alesi*, from Mt. Makiling, **Luzon**; in British Mus. (seen).

Occurrence in New Guinea. Represented only by the following subspecies.

Notes. The synonymy suggested above is based on examination of the types of *issus* and *alesi* at the British Museum, and comparison with many specimens from other localities. They seem to represent one variable species which is widely distributed in **SE. Asia**, **Sumatra**, **Borneo**, the **Philippines**, **New Guinea**, and **New Britain**, and presumably intervening islands too.

My single specimen of *siamensis* (*issus*) from Borneo has distinct basal pronotal

setae on both sides, but they rise from scarcely detectable punctures that could hardly be seen if the setae were missing. Some, but perhaps not all, of my specimens of this species (*alesi*) from Leyte have these setae present too. However, I have carefully examined both sides of all 36 specimens of the species from New Guinea and 16 from New Britain, and can find no trace of basal pronotal setae or punctures in any of them. This gives a basis for separating the New Guinea-New Britain population as a geographical subspecies (below). First, however, I have had to discuss *siamensis* as a whole, in order to establish the synonymy and distribution of the species.

Oodes siamensis vulsus n. subsp.

Description. Similar to *siamensis sensu stricto* (above) but without seta-bearing punctures on basal edge of pronotum. *Head* 0.51 and 0.51 width prothorax. *Prothorax*: width/length 1.57 and 1.63; base/apex 1.81 and 1.84. *Elytra*: width elytra prothorax 1.08 and 1.07. *Measurements*: length *c.* 8–9; width 3.3–3.7 mm.

Types. Holotype ♂ (M.C.Z., Type No. 31,357) and 13 paratypes from Dobodura, **Papua**, Mar.–July 1944 (Darlington). Additional paratypes from **West N. G.**: 20, Hollandia, July–Sept. 1944 (Darlington); 1, Maffin Bay, Aug. 1944 (Darlington); 1, "Neth. New Guinea," Oct. 20, 1944 (T. Aarons, California Acad.).

Measured specimens. The ♂ holotype and 1 ♀ paratype from Dobodura.

Notes. This subspecies occurs also in **New Britain** (16, Cape Gloucester, Darlington, M.C.Z.).

Oodes denisonensis Castelnau

Castelnau 1867, Notes on Australian Coleoptera, p. 64.

Sloane 1910, Proc. Linnean Soc. New South Wales 35, pp. 445, 447.

Csiki 1931, Coleop. Cat., Carabidae, Harpalinae 5, p. 1007.

Description (for recognition only). Form broad, convex; for technical characters see Sloane's (1910) key, and preceding *Key to Species of Oodes of New Guinea*; length *c.* 13.5–15 mm.

Type. From Port Denison (probably near Bowen, Queensland), **Australia**; present location of type unknown (not seen).

Occurrence in New Guinea. **Papua**: 1 ♀, Rouku, Morehead R., Apr. 1962 (W. W. Brandt, C.S.I.R.O.). **West N. G.**: 1 ♀, Merauke (south coast), sea level, Mar. 28, 1955 (L. D. Brongersma, Leiden Mus.).

Notes. The distinctive characters of *denisonensis* are based on the ♂. The two ♀ ♀ from New Guinea agree well in non-sexual details with specimens from Queensland, Australia (from Gayndah, Rockhampton, Townsville, and Kuranda).

Oodes siccus n. sp.

Description. Form and convexity average; black, basal angles of prothorax and appendages slightly more reddish; moderately shining, whole upper surface finely *c.* isodiametrically microreticulate and punctulate. *Head* 0.52 and 0.51 width prothorax; labrum 6-setose; clypeus not margined, with 1 seta-bearing puncture each side well behind angle; 1 (posterior) seta-bearing puncture over each eye; front weakly convex, scarcely impressed anteriorly; mentum with rounded-triangular tooth. *Prothorax*: width/length 1.59 and 1.68; base/apex 1.82 and 1.83; disc with fine middle line, vague wide baso-lateral impressions, and seta-bearing puncture each side on basal edge inside angle. *Elytra*: width elytra/prothorax 1.08 and 1.09; base margined; humeri not dentate; striae moderately impressed, faintly punctulate; intervals slightly convex, 8th wide at base, 3rd 2-punctate. *Inner wings* full. *Lower surface*: prosternal process not margined between coxae; sides of body including metepisterna closely punctate. *Secondary sexual characters*: ♂ with front tarsi slightly narrower than usual (2nd segments slightly longer than wide), with usual 3 segments densely squamulose; ♂ with 1, ♀ 2 setae each side last ventral segment. *Measure-*

ments: length *c.* 10–11; width 4.0–4.5 mm.

Types. Holotype ♂ (M.C.Z., Type No. 31,358) and 12 paratypes from Dobodura, **Papua**, Mar.–July 1944 (Darlington); and additional paratypes as follows. **Papua**: 6, Lake Daviumbu, Fly R., Aug. 19–30, Sept. 1–10, 11–20, 1936 (Archbold Exp., A.M. N.H.). **West N. G.**: 8, Hollandia, July–Sept. 1944 (Darlington).

Measured specimens. The ♂ holotype and 1 ♀ paratype from Dobodura.

Notes. This is similar to *Oodes cribristernis* and its allies, but differs in having a distinct basal elytral margin. It is similar also to *O. nil* (described above) but clypeal and basal pronotal setae are present (absent in *nil*), the elytral striae are less obviously punctate, and the punctures of the 3rd intervals are less impressed.

O. siccus occurs also on Morotai Is. in the **Moluccas** (Darlington, M.C.Z.).

Oodes *par* n. sp.

Description. Form (Fig. 14) more quadrate than usual, depressed; black, appendages in part more rufous; dorsal microsculpture of fine *c.* isodiametric meshes with very little additional punctulation. *Head* 0.57 and 0.59 width prothorax; labrum 6-setose; clypeus not margined, with seta-bearing puncture each side behind angle; 1 (posterior) seta over each eye; mentum tooth entire, bluntly triangular. *Prothorax*: width/length 1.57 and 1.61; base/apex 1.62 and 1.51; disc depressed, with moderate middle line, vague transverse impressions, distinct but poorly defined rounded baso-lateral impressions (sublinear in some lights), and strong seta on basal edge each side inside angle. *Elytra* subquadrate; width elytra/prothorax 1.11 and 1.13; basal margin obsolete; humeri not dentate; striae impressed, punctulate; intervals slightly convex, 8th wide to base, 3rd 2-punctate. *Inner wings* full. *Lower surface*: prosternal process not distinctly margined between coxae; sides of body including metepisterna vaguely or not punctate. *Secondary sexual characters*: ♂ front tarsi moderately dilated (2nd segments barely wider than long), 3 segments densely squamulose; ♂ with 1, ♀ 2 seta-bearing punctures each side last ventral segment. *Measurements*: length *c.* 11–12; width *c.* 4.6 mm.

Types. Holotype ♂ (M.C.Z., Type No. 31,359) from Aitape, **N-E. N. G.,** Aug. 1944 (Darlington); and 1 ♀ paratype, Hollandia, **West N. G.,** July–Sept. 1944 (Darlington).

Notes. The technical characters, especially the positions of setae and loss of the basal elytral margin, suggest that this new species may be allied to *O. cribristernis* and *longior*, but *par* differs from both in being more quadrate and in having the lower surface including the metepisterna relatively smooth.

Oodes *cribristernis* Bates

Bates 1892, Ann. Mus. Civ. Genoa 32, p. 323.
Csiki 1931, Coleop. Cat., Carabidae, Harpalinae 5, p. 1007.
Andrewes 1940, Proc. R. Ent. Soc. London (B) 9, p. 204 (in key).

Description (for recognition only). Form moderately slender, depressed; distinguishing characters indicated in preceding *Key to Species of Oodes of New Guinea* and in Andrewes' (1940) key. *Prothorax*: width/length 1.67 and 1.63; base/apex 1.63 and 1.58. *Elytra*: width elytra/prothorax 1.10 and 1.13. *Measurements* (of New Guinean specimens): length 10.5–13.5; width 4.2–5.5 mm.

Type. From **Burma**, in Genoa Mus. (not seen).

Occurrence in New Guinea. **Papua**: 27, Milne Bay, Dec. 1943 (Darlington); 14, Dobodura, Mar.–July 1944 (Darlington); 1, Mt. Lamington, 1300–1500 ft. (*c.* 400–450 m) (C. T. McNamara, S. Australian Mus.). **N-E. N. G.**: 1, Lae, Oct. 1944 (Darlington); 2, Aitape, Aug. 1944 (Darlington); 4, Finschhafen, Huon Pen., 10 m, Apr. 9–16, 1963 (Sedlacek); 1, Wau, Mt. Missim, Morobe Dist., 880–1050 m, Feb. 8–9, 1963 (Sedlacek). **West N. G.**: 1, Maffin Bay, Aug. 1944 (Darlington); 7, Sansapor, Aug. 1944 (Darlington); 1, "Neth.

New Guinea" without further locality, Oct. 20, 1944 (T. Aarons, California Acad.).

Measured specimens. A pair (♂ ♀) from Dobodura.

Notes. The specimens from New Guinea here recorded as *cribristernis* possess all significant characters given in Bates' brief description and Andrewes' key (1940), but direct comparison will be necessary to confirm the identification. The species (if it is one species) is now known from **Burma**, **Sumatra**, and **New Guinea**. *O. oblongus* Castelnau of Australia seems to be allied but is larger, duller, with finer elytral striae.

Oodes longior n. sp.

Description. Form as in Figure 15, slender, depressed; black, posterior angles of prothorax and parts of appendages (especially tarsi, palpi, antennae) ± reddish; moderately shining, entire upper surface with fine *c.* isodiametric microsculpture and very fine inconspicuous punctulation. *Head* 0.56, 0.58, and 0.59 width prothorax; labrum 6-setose; clypeus not margined, with a seta each side behind angle; 1 (posterior) seta-bearing puncture over each eye; mentum tooth moderate, impressed or slightly emarginate. *Prothorax*: width/length 1.46, 1.44, and 1.49; base/apex 1.70, 1.66, and 1.69; disc with light middle line, no distinct subbasal impressions but faintly impressed each side at extreme base; 1 seta-bearing puncture on basal edge each side near narrowly rounded basal angles. *Elytra*: width elytra/prothorax 1.07, 1.09, and 1.09; basal margin obsolete; humeri not dentate; apices subangulate near suture (opposite 1st intervals); striae lightly impressed, faintly punctulate; intervals slightly convex, 8th slightly narrower than 7th at base, 3rd 2-punctate. *Inner wings* full. *Lower surface*: prosternal process not distinctly margined between coxae; sides of body below including metepisterna rather finely, closely punctate. *Secondary sexual characters*: ♂ front tarsi moderately dilated (2nd segment *c.* wide as long), 3 segments densely squamulose below; ♂ with 1, ♀ 2 seta-bearing punctures each side last ventral segment. *Measurements*: length *c.* 14–15; width 5.2–5.4 mm.

Types. Holotype ♂ (M.C.Z., Type No. 31,360) and 1 ♀ paratype from Hollandia, **West N. G.,** July–Sept. 1944 (Darlington); and 1 ♂ paratype from Ambunti, Sepik R., **N-E. N. G.,** May 16, 1929 (Crane-Field Mus. Pacific Exp., Chicago Mus.).

Measured specimens. The ♂ holotype, ♀ paratype from Hollandia, and ♂ paratype from Ambunti, in this order.

Notes. This new species has the technical characters (setae, etc.) of *cribristernis* (above) but is larger and more slender (*cf.* proportions of *cribristernis*), with elytra subangulate at apex.

Although *cribristernis*, like most Oodini, lives in very wet places, *longior* may be even more aquatic. My 2 specimens were taken in comparatively deep water in floating debris and vegetation.

Tribe HARPALINI

Sloane 1898, Proc. Linnean Soc. New South Wales 23, pp. 455, 456 (key to Australian genera).

Csiki 1932, Coleop. Cat., Carabidae, Harpalinae 6, pp. 1023–1268.

Van Emden 1953, Ann. Mag. Nat. Hist. (12) 6, pp. 513 ff. (discussion in text).

Harpalidae Jeannel 1942, Faune de France, Coléop. Carabiques, Part 2, pp. 575–584.

Harpalinae Basilewsky 1951–1952, Ann. Mus. Congo Belge (8), Zool., Vols. 6 and 9 (revision of African and Madagascan forms).

The tribe Harpalini contains a large proportion of the common, medium-sized Carabidae that live on the ground in all climates in all parts of the world. They are very numerous in open country, fewer in rain forest. Those that do live in rain forest include many *Lecanomerus* in eastern Australia and most *Trichotichnus* in New Guinea. The tribe also contains many smaller species that live in wet places or beside quiet (usually not rapidly running) water.

Classification of genera within the Harpalini is exceptionally difficult, perhaps (I suspect) because the tribe is relatively re-

cent in evolution and dispersal. Generic classifications proposed for members of the tribe in any one region fail in other regions, and no usable classification exists for the genera of the Oriental Region and Malay Archipelago. The arrangement of genera in the Junk Catalogue (Csiki, 1932) is said to follow Schauberger, but he died without explaining it. The classification that I am using for the New Guinean forms (see *Key*, below) is based partly on well known characters that are probably phylogenetic, but nevertheless the key is partly superficial and is intended primarily as an aid in identification, not as a contribution to harpaline classification.

Characters drawn from the soles of the male tarsi are fundamental in harpaline taxonomy but are, of course, useless in the case of unassociated females. (The single possible *Trichotichnus* that I have from Australia is a female and therefore not identifiable!) And characters of the mouthparts, including the setae of the penultimate segments of the labial palpi, are fundamental too, but are difficult to see and understand. Even experienced carabid specialists make mistakes in placing harpaline genera. Bates' original placing of *Lamprophonus* and Andrewes' of *Carbanus* are examples. Both genera were originally wrongly characterized and put in the wrong subtribes. Many of the harpalines that I have for study from New Guinea were taken in light traps, and this increases the difficulty. Light-trap specimens often have moth scales adhering to and concealing their mouthparts and tarsal soles, and scales stuck to the tarsal soles may even counterfeit sexual squamae.

The distribution of Harpalini over the world has been misunderstood until recently because of lack of adequate subtribal and generic classifications, and because of incorrect assignments of many Australian and South American species to northern genera, especially to *Harpalus* and *Anisodactylus*. Van Emden (1953), however, has suggested what I think are natural and useful subtribes and has indicated their distributions. His arrangement, slightly modified, is summarized in Table 1.

TABLE 1. DISTRIBUTION OF PRINCIPAL SUBTRIBES OF HARPALINI (AFTER VAN EMDEN 1953)

1. Anisodactylina: worldwide, but irregularly distributed; genera in Australia and South America are probably not directly related.

2. Harpalina, Harpali (*Harpalus* and its immediate allies): throughout Eurasia, Africa (and Madagascar), and North America; absent in Australia and South America.

3. Harpalina, Selenophori: most of the world including South America, but absent in most of Australia (one or two Oriental genera reach just the northern edge of Australia).

4. Pelmatellina: chiefly Australia and South (and Central) America. The genus *Nemaglossa* may occur in both Australia and South America but has not been adequately studied.

5. Acupalpina: nearly worldwide, with some genera very widely distributed. The members of this subtribe are mostly small, water-loving forms which do not compete with most members of the other subtribes, except perhaps with small Pelmatellina in Australia.

This outline of harpaline distribution (Table 1) is, of course, an oversimplification. A more detailed study of the distribution of subtribes of Harpalini would be an important contribution to insect zoogeography.

Within the limits of New Guinea and Australia, harpaline faunae overlap complexly. Among larger, terrestrial Harpalini at low altitudes, several primarily Australian genera of subtribe Anisodactylina (*Gnathaphanus, Diaphoromerus, Hypharpax*) extend to New Guinea and westward into or across the Malay Archipelago. These genera live chiefly in relatively open country, including open *Eucalyptus* woodland, although some of them enter rain forest too. On the other hand, several primarily Oriental genera of subtribe Harpalina, especially *Trichotichnus* and other Selenophori (but not *Harpalus*), reach New Guinea and are dominant there, outnumbering the Australian Anisodactylina especially in rain forest. These genera either

do not extend to Australia or are represented there by single species on the extreme northern edge of the continent (e.g., a *Coleolissus* on Cape York). The Australian genera, chiefly in more open country, and the Oriental ones, chiefly in rain forest, are in part ecologically as well as geographically complementary. This pattern suggests recent multiple invasions of the rain-forested areas of New Guinea by Oriental stocks and of the more open areas by Australian stocks, but over a long period some replacement of Australian by incoming, competing Oriental groups may have occurred.

At much higher altitudes on New Guinea is one additional genus of Anisodactylina, *Chydaeus*, which is primarily Asiatic and has apparently "mountain hopped" across the Malay Archipelago. This genus does not reach Australia.

Among smaller, water-loving Harpalini, primarily Oriental Acupalpina are dominant in New Guinea and several genera reach the northern half of Australia, but they decrease or disappear in southern Australia. Their place there is taken by small Pelmatellina (*Lecanomerus*), which are numerous throughout Australia and a few of which occur in New Guinea (described in the following pages) but which are unknown farther west in the Malay Archipelago. The distributions of Oriental Acupalpina and of small Australian Pelmatellina are therefore broadly complementary too in the Australian Region, but with wide and complex overlapping.

Key to Genera of Harpalini of New Guinea

1. Male front and middle tarsi with sponge-like soles of many densely packed, narrow adhesive hairs 2
– Male front and usually (not always) middle tarsi 2-seriately squamulose below, or rarely (*Lyter* only) with more than 2 rows of long, narrow scales loosely arranged 6
2. Size larger (6–16 mm); scutellar striae present (short in *Hypharpax*); penultimate segments labial palpi plurisetose (Anisodactylina) 3
– Size smaller (less than 5 mm in New Guinea); scutellar striae absent; penultimate segments labial palpi 2-setose (Pelmatellina) (p. 45) ..... *Lecanomerus*
3. Elytra without dorsal punctures; wings atrophied; (found only on high mts.) (p. 47) ..... *Chydaeus*
– Elytra each with 1 or more dorsal punctures; wings usually full 4
4. Elytra with several or many conspicuous dorsal punctures (p. 41) *Gnathaphanus*
– Elytra each with 1 dorsal puncture 5
5. Posterior tarsi long, basal segment much more than 2× long as wide; hind femora not strongly curved (p. 42) ..... *Diaphoromerus*
– Posterior tarsi shorter, basal segment 2× or less long as wide; hind femora of ♂ strongly curved, of ♀ less so (p. 44) *Hypharpax*
6. Penultimate segment labial palpi with more than 2 setae anteriorly; often larger (5–11 mm) (Harpalina) 7
– Penultimate segment labial palpi 2-setose anteriorly; often smaller (2.7–8.0 mm) (Acupalpina) 12
7. Front tibiae broader, apex ¼ or ⅓ wide as tibial length (by measurement) (p. 59) ..... *Harpaloxenus*
– Front tibiae narrower 8
8. Entire upper surface pubescent (p. 48) ..... *Platymetopus*
– Upper surface not pubescent 9
9. Elytra with 3rd intervals 1-punctate or impunctate 10
– Elytra with 3rd intervals with several (very small) punctures 11
10. Male front and middle tarsi with soles of long, slender, loose (not 2-seriate) scales; base of prosternum and base of abdomen not pubescent (p. 63) *Lyter*
– Male front and (usually) middle tarsi 2-seriately squamulose; base of pronotum and base of abdomen usually short-pubescent (but see *Notes* under *T. medius*) (p. 48) *Trichotichnus*
11. Last ventral segment with 2 setae each side in both sexes; elytra with sutural angles denticulate (in New Guinean species) (p. 64) ..... *Coleolissus*
– Last ventral segment with 1 seta each side in both sexes; sutural angles not denticulate (p. 66) *Hypharpax*
12. Scutellar striae absent; anterior marginal line of pronotum deep and entire; length *c.* 7–8 mm (p. 68) *Anoplogenius*
– Scutellar striae present; anterior marginal line of pronotum fine or interrupted at middle; usually smaller 13
13. Abdomen not pubescent (except for fixed setae) (p. 69) *Egadroma*

– Abdomen pubescent at least near apex 14
14. Prosternum without long setae anteriorly (p. 71) ..... *Stenolophus*
– Prosternum with several long setae anteriorly (p. 72) ..... *Acupalpus*

Genus *GNATHAPHANUS* Macleay

Macleay 1825, Annulosa Javanica 1, p. 20.
Chaudoir 1878, Ann. Mus. Civ. Genoa 12, pp. 476, 503.
Sloane 1900, Proc. Linnean Soc. New South Wales 24, p. 553 (key to some Australian species).
Csiki 1932, Coleop. Cat., Carabidae, Harpalinae 6, p. 1041 (see for synonymy and additional references).

Diagnosis. See preceding *Key to Genera of Harpalini of New Guinea.*

Description. None required here.

Type species. G. vulneripennis Macleay, of Java, etc.

Generic distribution. Many species in **Australia**, fewer in the **Malay Archipelago** and adjacent corner of **Asia**, with one or two widely distributed species reaching **India**, the **Philippines**, and islands east to **Samoa** and **New Caledonia**.

Notes. Some species of this genus have very wide ranges, within the limits given above. Of the 5 species known in New Guinea, all are shared with Australia and several are widespread also on the Malay Archipelago or islands of the western Pacific. These insects are often common in open country including grassland and open woodland, but are not often found in rain forest. All species of the genus that I know are fully winged and probably fly.

KEY TO SPECIES OF *GNATHAPHANUS* OF NEW GUINEA

1. Elytra with intervals 3, 5, and usually 7 (at least posteriorly) with dorsal punctures *conspicuously* impressed; (black, legs black; elytra deeply sinuate and acuminate at apex) (p. 41) ..... *licinoides*
– Elytra with fewer, less impressed dorsal punctures 2
2. Elytra with series of dorsal punctures on outer edges of intervals 3 and (at least posteriorly) 5; (legs yellow) (p. 41) .... *upolensis*
– Elytra with series of dorsal punctures only on 3rd intervals (single punctures sometimes present on other intervals) 3
3. Smaller (*c.* 9–10 mm); more shining (especially the ♂); piceous, legs brownish yellow (p. 42) ..... *picipes*
– Larger (*c.* 12–13 mm); dull black or metallic, legs black 4
4. Head and prothorax green, elytra cupreous (except in discolored individuals); posterior angles of prothorax distinct, bluntly obtuse or very narrowly rounded (p. 42) ..... *pulcher*
– Dull black; posterior angles of prothorax broadly rounded (p. 42) ..... *philippensis*

Gnathaphanus licinoides Hope

Hope 1842, Ann. Mag. Nat. Hist. 9, p. 427.
Csiki 1932, Coleop. Cat., Carabidae, Harpalinae 6, p. 1042 (see for synonymy and additional references).

Description. None required here; see *Key*, above; length *c.* 10 mm.

Type(s). From Port Essington, northern **Australia**; presumably in Hope Mus., Oxford (not seen).

Occurrence in New Guinea. **Papua**: 24, Dobodura, Mar.–July 1944 (Darlington); 1, Kokoda, 1200 ft. (366 m), Sept. 1933 (Cheesman); 1, Wakaiuna, Sewa Bay, Normanby Is., Jan. 1–8, 1957 (W. W. Brandt, Bishop Mus.). **N-E. N. G.**: 18, Wau, 1200 m, dates in Jan., Mar., Apr., June, July, Sept., Nov., Dec. 1961–1963 (Sedlaceks); 1, Stephansort, Astrolabe Bay, 1899 (Biró); 1, Aitape, Aug. 1944 (Darlington). **West N. G.**: 1, Hollandia, May 1945 (B. Malkin, U.S.N.M.); 1, same area, Cyclops Mts., 50–100 m, June 22–24, 1959 (Gressitt, T. C. Maa, Bishop Mus.), in light trap.

Notes. The known range of *licinoides* includes northern **Australia**, **New Britain**, the **Solomons**, **New Hebrides**, and **New Caledonia**, as well as **New Guinea**.

Gnathaphanus upolensis (Csiki)

Csiki 1915, Denkschriften Akad. Wiss. Wien, Math-Nat. 91, p. 163 (*Dioryche*).
Csiki 1932, Coleop. Cat., Carabidae, Harpalinae 6, p. 1044 (see for synonymy and additional references).
impressipennis Castelnau 1867, Notes on Australian Coleop., p. 100 (in *Harpalus*, but not *Harpalus impressipennis* Motschulsky 1844).
Chaudoir 1878, Ann. Mus. Civ. Genoa 12, p. 510.

Description. None required here; length *c.* 8–9 mm.

Types. Of *impressipennis*, from Rockhampton, **Australia**; in Genoa Mus. Of *upolensis*, from Upolu, **Samoa**; in Vienna Mus. (not seen).

Occurrence in New Guinea. Common (175 specimens seen) probably throughout **New Guinea** at low altitudes including Dobodura, up to 1200 m at Wau and to 2300 m on Mt. Kaindi (near Wau). Specimens taken in every month.

Notes. This very common carabid occurs usually in relatively open country, including grassland and open *Eucalyptus* woodland, from the **Malay Peninsula** across the **Malay Archipelago** to **New Guinea** and **Australia**, east at least to the **Philippines** and **Samoa**, and **New Caledonia**.

Gnathaphanus picipes (Macleay)

Macleay 1864, Trans. Ent. Soc. New South Wales 1, p. 117 (*Harpalus*).
Chaudoir 1878, Ann. Mus. Civ. Genoa 12, p. 509.
Csiki 1932, Coleop. Cat., Carabidae, Harpalinae 6, p. 1043 (see for synonymy and additional references).

Description. None required here; length *c.* 9–10 mm.

Types. From Port Denison (Bowen), Queensland, **Australia**; probably in Macleay Mus., Sydney (not seen).

Occurrence in New Guinea. **Papua**: 12, Port Moresby, Jan., Feb., Mar., May, Aug., Oct., Dec. (various collectors; M.C.Z., British Mus., Bishop Mus., U.S.N.M., Dept. Agr. Port Moresby), some under logs in *Eucalyptus* country, some at light; 2, Brown R., May 22, 25, 1956 (E. J. Ford, Jr., Bishop Mus.).

Notes. This northeastern Australian species apparently extends only to the southern edge of New Guinea.

Gnathaphanus pulcher (Dejean)

Dejean 1829, Species Général Coléop. 4, p. 282 (*Harpalus*).
Chaudoir 1878, Ann. Mus. Civ. Genoa 12, p. 505.
Csiki 1932, Coleop. Cat., Carabidae, Harpalinae 6, p. 1043 (see for synonymy and additional references).

Description. None required here; length *c.* 13–16 mm.

Types. From "Nouvelle-Hollande" (= **Australia**); presumably in Oberthür Coll., Paris Mus. (not seen).

Occurrence in New Guinea. **Papua**: 13, Port Moresby area, various dates in Jan., Feb., Mar., May (various collectors; Dept. Agr. Port Moresby); 3, Bisianumu, 1600 ft. (485 m), Feb. 12, 1966 (J. H. Barrett, Dept. Agr. Port Moresby).

Notes. This Australian species apparently reaches only the southern part of New Guinea, perhaps only the open-wooded *Eucalyptus* areas where many other Australian insects occur. It is represented on the Lesser Sunda Islands, west to Bali, by subspecies *extrarius* Schauberger.

Gnathaphanus philippensis (Chevrolat)

Chevrolat 1841, Revue Zool., p. 221 (*Amblygnathus*).
Chaudoir 1878, Ann. Mus. Civ. Genoa 12, p. 511 (as *laeviceps* Macleay).
Csiki 1932, Coleop. Cat., Carabidae, Harpalinae 6, p. 1043 (see for synonymy and additional references).

Description. None required here; length *c.* 12–16 mm.

Type(s). From "Manille" (**Manila**); in Hope Mus., Oxford (not seen).

Occurrence in New Guinea. **Papua**: 1, Kokoda, 1200 ft. (366 m), May 1933 (Cheesman); 3, Rouku, Morehead R., West Papua, Apr. 1962 (W. W. Brandt, C.S.I.R.O.).

Notes. This species ranges from SE. **Asia** to **Australia**, east to **Philippines**, but is surprisingly scarce and perhaps localized in **New Guinea**.

Genus *DIAPHOROMERUS* Chaudoir

Chaudoir 1843, Bull. Soc. Nat. Moscow 16, Part 2, p. 402.
——— 1878, Ann. Mus. Civ. Genoa 12, p. 476.
Csiki 1932, Coleop. Cat., Carabidae, Harpalinae 6, p. 1044 (see for additional references).

Diagnosis. See *Key to Genera of Harpalini of New Guinea.*

Description. None required here.

Type species. D. iridipennis Chaudoir, of Australia including Cape York (Chaudoir 1878).

Generic distribution. Primarily **Australia**, with species also on **New Zealand**, **New Caledonia**, **New Guinea**, the **Moluccas** (Amboina), and **Timor**, and with 2 New Guinean species extending to **New Britain**.

Notes. Many species of this genus in Australia inhabit open *Eucalyptus* woodland or grassland. The two species in New Guinea occur in rain-forested parts of the island, but I do not know their exact habitats. The New Guinean species of *Diaphoromerus*, like most Australian ones, are winged.

Key to Species of *Diaphoromerus* of New Guinea

1. Larger (8.5–10.5 mm); posterior angles of prothorax (narrowly) rounded (p. 43) ..... *papuensis*
– Smaller (6.0–7.5 mm); posterior angles of prothorax obtusely angulate, scarcely blunted (p. 43) ..... *papuellus*

Diaphoromerus papuensis (Macleay)

Macleay 1876, Proc. Linnean Soc. New South Wales 1, p. 168 (*Harpalus*).
Csiki 1932, Coleop. Cat., Carabidae, Harpalinae 6, p. 1043 (*Gnathaphanus*).
basilewskyi Louwerens 1962, Tijdschrift voor Ent. 105, p. 139 (*Gnathaphanus*) (new synonymy).

Description. None required here; length *c.* 9–10 mm.

Types. Of *papuensis*, from Hall Sound, Papua; presumably in Macleay Mus., Sydney (not seen). Of *basilewskyi*, from Amboina Is., **Moluccas**, 70 m altitude (A. M. R. Wegner), at light; holotype in Louwerens Coll. (not seen), 2 paratypes now in M.C.Z.

Occurrence in New Guinea. Common probably throughout **New Guinea**: 119, from widely scattered lowland localities, from Port Moresby and Dobodura to Manokwari, up to 1300 m at Wau, and 800 m at Araucaria Camp, West N. G. Specimens collected in every month except August.

Notes. Macleay's statement that the third elytral interval is punctate on inner side before apex places this species in *Diaphoromerus* rather than *Gnathaphanus*, and the length (4½ lines = 9 mm) is diagnostic of this species in New Guinea. Closely related species in Australia probably include *melanarius* Dejean and *iridipennis* Chaudoir. *D. papuensis* occurs also in **New Britain** (Cape Gloucester, Darlington) and the **Moluccas** (types of *basilewskyi*).

Diaphoromerus papuellus n. sp.

Description. Form as in Figure 16, rather small, convex; brownish piceous, appendages testaceous or brownish testaceous; moderately shining, ♀ scarcely duller, both sexes with reticulate microsculpture isodiametric or slightly transverse on head, more transverse on pronotum and elytra. *Head* 0.69 and 0.69 width prothorax; eyes prominent; front weakly impressed; mentum toothed; ligula slightly shorter than paraglossae, latter separate at apex. *Prothorax* transverse-subquadrate; width/length 1.43 and 1.44; base/apex 1.41 and 1.39; sides rounded anteriorly, nearly straight, converging, sometimes slightly sinuate before slightly obtuse but distinct and scarcely blunted basal angles; disc formed as usual, basal impressions sublinear, weak, margined at base but not or indistinctly punctate. *Elytra*: width elytra/prothorax 1.20 and 1.19; sides slightly sinuate before apex; striae impressed; intervals slightly convex, subequal, 3rd 1-punctate on inner side near apex. *Inner wings* full. *Legs*: 1st segment hind tarsi elongate. *Secondary sexual characters*: ♂ front and middle tarsi dilated (2nd and 3rd segments of front tarsi slightly wider than long, of middle tarsi narrower), with densely pubescent soles. *Measurements*: length 6.0–7.5; width 2.0–2.8 mm.

Types. Holotype ♂ (British Mus.) and 6 paratypes (some in M.C.Z., Type No. 31,361) from Kokoda, **Papua**, 1200 ft. (366 m), Aug. (except one specimen May) 1933 (Cheesman); and additional paratypes as follows. **Papua**: 1, Kerema, May 3–9, 1959 (C. D. Michener, Bishop Mus.); 2, Kiunga, Fly R., July 4–8, Aug. 8–10, 1957 (W. W. Brandt, Bishop Mus.); 1, Rouku, Morehead

R., West Papua, Apr. 1962 (W. W. Brandt, C.S.I.R.O.); 3, Yule Is. (Hungarian National Mus.); 39, "Papua" without further locality (Hungarian National Mus.). **West N. G.**: 2, Merauke, Apr. 6, 1952 (L. D. Brongersma, Leiden Mus.); 1, same locality, Jan. 26–Feb. 10, 1960 (T. C. Maa, Bishop Mus.); 1, Kepi, Res. Mappi, Oct. 15, 1957 (R. T. Simon Thomas, Louwerens Coll.); 4, Wasian, Sept. 27, 1939 (R. G. Wind, California Acad.). Also 1 paratype, Koitaki, 1500 ft. (455 m), New Guinea (division unknown), Oct.–Nov. 1928 (Pemberton, H.S.P.A.).

Measured specimens. The ♂ holotype and 1 ♀ paratype from Kokoda.

Notes. I have seen a specimen of this species from Keravat, **New Britain** (E. J. Ford, Jr., Bishop Mus.).

This is evidently a member of the *Diaphoromerus australis* group. As compared with *australis* itself, the present new species has better defined posterior prothoracic angles. In this character it agrees with *D. aereus* Dejean, of SW. Australia, but *papuellus* lacks the obvious punctation of the base of the pronotum of *aereus*. As compared with *queenslandicus* Csiki (*mandibularis* Castelnau), *papuellus* is larger, with more obtuse posterior prothoracic angles.

Genus *HYPHARPAX* Macleay

Macleay 1825, Annulosa Javanica 1, p. 22.
Chaudoir 1878, Ann. Mus. Civ. Genoa 12, p. 496.
Sloane 1898, Proc. Linnean Soc. New South Wales 23, pp. 458–459.
Csiki 1932, Coleop. Cat., Carabidae, Harpalinae 6, p. 1051 (see for synonymy and additional references).

Diagnosis. See preceding *Key to Genera of Harpalini of New Guinea.*

Description. None required here.

Type species. H. lateralis Macleay (= *dentipes* Wiedemann), of Java.

Generic distribution. Chiefly **Australia**, extending to **New Zealand**, and west in the **Malay Archipelago** to **Java** and **Sumatra**.

Notes. See *Notes* under following species.

Hypharpax dentipes (Wiedemann)

Wiedemann 1823, Zool. Magazin 2, p. 54 (*Harpalus*).
Chaudoir 1878, Ann. Mus. Civ. Genoa 12, p. 500.
Andrewes 1919, Trans. Ent. Soc. London for 1919, p. 158.
Csiki 1932, Coleop. Cat., Carabidae, Harpalinae 6, p. 1052 (see for synonymy and additional references).

Description. None required here. This is the only species of the genus known from New Guinea. Length c. 7–10 mm.

Type. From **Java**; in Copenhagen Zool. Mus. (not seen).

Occurrence in New Guinea. **Papua**: 39, Port Moresby and vic., May, Sept., Oct., Dec. (various collectors; M.C.Z., British Mus., Bishop Mus., Dept. Agr. Pt. Moresby), some under logs in *Eucalyptus* country, some at light; 6, Yule Is., Nov. 7 and 16, 1933 (R. V. Oldham, British Mus.); 2, same locality (Fry Coll., British Mus.); 1, Lake Daviumbu, Fly R., Sept. 11–20, 1936 (Archbold Exp., A.M.N.H.); 1, Rouku, Morehead R., West Papua, Mar. 1962 (W. W. Brandt, C.S.I.R.O.). **N-E. N. G.**: 3, Lae and vic., Mar. 1963, Aug. 1964 (Sedlacek); 18, Sum-Sum, 64 km N. of Wau, 580 m, Feb. 15, 1963 (H. W. Clissold, Bishop Mus.); 4, Bulolo, 720 m, Aug. 13, 19, 24, 27, 1956 (E. J. Ford, Jr., Bishop Mus.), 2 of these taken in light trap; 1, Wau, 1200 m, May 1–15, 1962 (Sedlacek) in light trap. Also 7 specimens from Papua, "British N. Guinea," and New Guinea without exact localities.

Notes. The sexes of *dentipes* differ considerably: males not only have the front and middle tarsi dilated, with spongy soles, but also have the hind femora more or less dentate and the hind tibiae more or less curved. The development of the femoral tooth and the degree of curvature of the tibiae vary individually in males from single localities and also vary geographically, and the size of the insect varies geographically. The species therefore has received several names. The synonymy has not been fully worked out, but my impression is that a single variable species of *Hypharpax*,

for which *dentipes* is the oldest name, occurs in **Sumatra**, **Java**, **Celebes**, and **New Guinea**, and that it occurs also in **NE. Australia** under the name *krefti* Castelnau. This tentative conclusion should be tested by more rigorous study, for which I now have neither the material nor the time.

In New Guinea this species has been found only in the eastern half of the island, especially but not exclusively in the more open *Eucalyptus* country of southern Papua.

Genus *LECANOMERUS* Chaudoir

Chaudoir 1850, Bull. Soc. Nat. Moscow 23, Part 1, p. 446.
Sloane 1920, Proc. Linnean Soc. New South Wales 45, pp. 132, 137 (as synonym of *Nemaglossa*).
Csiki 1932, Coleop. Cat., Carabidae, Harpalinae 6, p. 1058 (as synonym of *Nemaglossa*) (see for additional references).
Thenarotes Bates 1878, Cistula Ent. 2, p. 319.

Diagnosis. Small Harpalini (length under 5 mm in New Guinea); elytra without scutellar striae (in New Guinean species); penultimate segments labial palpi conspicuously 2-setose; ♂ front and middle tarsi with densely pubescent soles.

Description (characters common to New Guinean species). Form *c.* as in Figures 17, 18; more compact and convex than in most Acupalpina, with margins of prothorax and elytra relatively narrow. *Head*: mandibles moderately long, straight posteriorly, curved apically; eyes not very large but almost contiguous with sides of mouth below; frontal impressions deep, curved, sharply defined; mentum with triangular tooth; ligula 2-setose, with paraglossae attached, longer than ligula; palpi short, apical segments subconical, penultimate segments of labial palpi 2-setose. *Prothorax* subquadrate or subcordate; disc convex, median longitudinal line impressed, baso-lateral impressions shallow and poorly defined, surface of disc punctate across base, almost impunctate elsewhere. *Elytra*: humeri prominent; basal margin entire, rounded or obtusely subangulate at humeri; striae impressed, entire, not distinctly punctate; scutellar striae lacking; 3rd intervals 1-punctate on inner edge behind middle. *Inner wings* full. *Lower surface* including abdomen virtually glabrous except for "fixed" setae. *Secondary sexual characters*: ♂ front and middle tarsi moderately dilated, with densely pubescent soles; 2 setae each side apex last ventral segment in both sexes.

Type species. Of *Lecanomerus*, *L. insidiosus* Chaudoir, of SW. Australia; of *Thenarotes*, *T. tasmanicus* Bates, of Tasmania.

Generic distribution. Species of *Lecanomerus* (*sensu lato*) are diverse in **Australia**, less so in **New Zealand**, **New Caledonia**, and **New Guinea**. For further details see *Notes*, below.

Notes. The supposed identity of *Lecanomerus* (including *Thenarotes*) of Australia and *Nemaglossa* of Chile is doubtful. Sloane (1920), who suggested it, did so without what would now be considered critical study, and I have not been able to make the comparisons necessary to confirm it. I shall therefore tentatively treat *Lecanomerus* as distinct from *Nemaglossa* and confined to the Australian Region. The genus does *not* have an "Antarctic" distribution pattern. Species are numerous and diverse along the whole eastern edge of Australia north to Cape York. Five species are reported from Tasmania (Sloane), but 4 of them occur on the Australian mainland too, and the 1 species endemic to Tasmania is not much differentiated.

The 3 small, compact *Lecanomerus* found in New Guinea resemble, but are specifically distinct from, certain unidentified species that I found common on the Cape York Peninsula of Australia in 1958. The New Guinean forms occur in rain-forest areas, not in *Eucalyptus* country. They probably live among dead leaves and under vegetation on the ground near standing water or perhaps sometimes in leaf litter on the floor of rain forest. However, I did not distinguish them in the field and cannot be sure of their habitats.

KEY TO SPECIES OF *LECANOMERUS* OF NEW GUINEA

1. Prothorax narrowly subcordate (width/length 1.22 and 1.18); (Hollandia, West N. G.) (p. 46) ..... *angustior*
– Prothorax wider; (Papua) 2
2. Brown; slightly narrower (*cf.* proportions in *Descriptions*); punctation of base of pronotum discontinuous, with middle of base virtually impunctate (p. 46) ..... *medius*
– Black; relatively slightly wider; punctation somewhat irregular but *c.* continuous across base of pronotum (p. 46) ..... *latior*

Lecanomerus angustior n. sp.

Description. With characters of genus; form (Fig. 17) narrowly compact; color brownish piceous, prothoracic and elytral margins and suture usually slightly rufescent, appendages testaceous; moderately shining, reticulate microsculpture faint, slightly transverse on front and on pronotal disc, more transverse on elytra. *Head* 0.69 and 0.69 width prothorax; eyes smaller than average, genae slightly rounded-oblique. *Prothorax*: width/length 1.22 and 1.18; base/apex 1.13 and 1.15; sides weakly rounded anteriorly, converging and usually sinuate posteriorly before *c.* right posterior angles; base and apex unmargined at least at middle; base of pronotum punctate at sides, scarcely so at middle. *Elytra*: width elytra/prothorax 1.47 and 1.45. *Measurements*: length 3.6–4.0; width 1.6–1.7 mm.

Types. Holotype ♂ (M.C.Z., Type No. 31,362) and 6 paratypes all from Hollandia, **West N. G.,** July–Sept. 1944 (Darlington).

Measured specimens. The ♂ holotype and 1 ♀ paratype.

Notes. See preceding *Key to Species* for differential characters. This is the westernmost known species of the genus. It probably represents *medius* (below) of eastern New Guinea. Perhaps additional related forms are still to be found in western West N. G.

Lecanomerus medius n. sp.

Description. With characters of genus; form average; color brownish piceous, margins of prothorax and elytra slightly or not rufescent, appendages testaceous, antennae slightly browner except at base; shining, reticulate microsculpture faintly indicated, meshes scarcely distinct at 50×. *Head* 0.64 and 0.65 width prothorax; eyes moderate, genae short, rounded. *Prothorax*: width/length 1.34 and 1.34; base/apex 1.26 and 1.27; sides broadly rounded except nearly straight and converging posteriorly to obtuse but finely denticulate posterior angles; base and apex unmargined at least at middle; base punctate at sides, not at middle. *Elytra*: width elytra/prothorax 1.36 and 1.34; humeri broadly rounded. *Secondary sexual characters* as for genus. *Measurements*: length 3.5–4.3; width 1.6–1.8 mm.

Types. Holotype ♂ (M.C.Z., Type No. 31,363) and 20 paratypes from Dobodura, **Papua**, Mar.–July 1944 (Darlington), and 9 paratypes, Oro Bay, near Dobodura, Dec. 1943–Jan. 1944 (Darlington).

Measured specimens. The ♂ holotype and 1 ♀ paratype from Dobodura.

Notes. See *Notes* under preceding and following species.

Lecanomerus latior n. sp.

Description. With characters of genus; form (Fig. 18) compact, relatively broad; black, appendages brownish testaceous; shining, *c.* without reticulate microsculpture. *Head* 0.68 and 0.67 width prothorax; eyes slightly larger than in *medius* (above), genae short, forming *c.* right angles with neck. *Prothorax*: width/length 1.36 and 1.39; base/apex 1.24 and 1.16; sides broadly rounded except *c.* straight and converging posteriorly to obtuse but minutely denticulate posterior angles; apex margined but marginal line sometimes faint at middle; base not margined; entire base of pronotum punctate, but punctures sparser at middle of base. *Elytra*: width elytra/prothorax 1.44 and 1.38; humeri obtusely sometimes vaguely subangulate. *Measurements*: length 3.6–3.7; width 1.6–1.7 mm.

Types. Holotype ♂ (M.C.Z., Type No. 31,364) and 1 ♀ paratype from Dobodura,

Papua, Mar.–July 1944 (Darlington); and additional paratypes from **Papua** as follows: 1, Bisianumu, near Sogeri, 500 m, Mar. 15–20, 1955 (E. O. Wilson, M.C.Z.), taken in rain forest; 1, Kokoda, 1200 ft. (366 m), Aug. 1933 (Cheesman).

Measured specimens. The ♂ holotype and ♀ paratype from Dobodura.

Notes. Distinguished from the 2 preceding species by broader form, black color, and pronotum with entire apical marginal line and more extensive basal punctation.

Genus *CHYDAEUS* Chaudoir

Chaudoir 1854, Bull. Soc. Nat. Moscow 27, Part 1, p. 343.
Csiki 1932, Coleop. Cat., Carabidae, Harpalinae 6, p. 1080.

Diagnosis. See *Key to Genera of Harpalini of New Guinea.*

Description. None required here.

Type species. C. obscurus Chaudoir, of India.

Generic distribution. The **Himalayas** (Sikkim, etc.), **Formosa**, **Sumatra**, **Java**, the **Philippines**, and **New Guinea**; usually at high altitudes.

Notes. This is the clearest case I know of an Asiatic stock of Carabidae that has "mountain hopped" to New Guinea. All species of the genus are generally similar and probably closely allied. The wings of some species have atrophied, but those of others are still fully developed, and *C. bakeri* Andrewes is dimorphically winged at Baguio on Luzon. Flying individuals may therefore have dispersed from mountaintop to mountaintop and from island to island across the Malay Archipelago rather recently, in terms of evolutionary time.

Chydaeus papua n. sp.

Description. Form as in Figure 19, stout, convex; black, legs brownish, antennae and mouthparts irregularly brownish testaceous; both sexes moderately shining, upper surface irregularly punctulate but reticulate microsculpture faint or absent. *Head* 0.76 and 0.74 width prothorax, *c.* as in *Chydaeus obscurus* Chaudoir; mentum toothed; ligula free at apex, truncate; paraglossae arcuate, narrow, *c.* long as ligula but widely separated from it. *Prothorax* broadly subcordate; width/length 1.48 and 1.49; base/apex 1.12 and 1.09; sides broadly rounded through much of length, sinuate before well defined *c.* right posterior angles; pronotum strongly convex (more so than in *obscurus*), base margined, basal impressions poorly defined, surface of disc more closely and coarsely punctate at sides and especially base than at middle. *Elytra*: width elytra/prothorax 1.21 and 1.25; humeri subdentate; apices weakly sinuate; striae entire, rather lightly impressed; 3rd intervals without dorsal punctures. *Inner wings* vestigial. *Lower surface* and *legs* without obvious special characters. *Secondary sexual characters*: ♂ front tarsi moderately and middle tarsi narrowly dilated, densely squamulose below; ♂ with 1, ♀ 2 setae each side last ventral segment. Measurements: length 9.2–10.6; width 3.6–4.4 mm.

Types. Holotype ♂ (M.C.Z., Type No. 31,365) and 6 paratypes from Mt. Wilhelm, Bismarck Rge., **N-E. N. G.,** above 10,000 ft. (above 3000 m), Oct. 1944 (Darlington), in open country above timberline; and additional paratypes as follows, all from the Bismarck Rge.: 2, Mt. Wilhelm, 2800–2900 m, July 6, 1963 (Sedlacek); 1, "No. 5," Piunde-Aude Camp, east slopes Mt. Wilhelm, June 13, 1959 (L. J. Brass, Sixth Archbold Exp. to Papua, A.M.N.H.); 1, Lake Aunde, 3400–3500 m, July 4, 1963 (Sedlacek); 1, Lake Sirunki, 2800–2900 m, June 15, 1963 (Sedlacek); 6, Mt. Otto Summit, Nov. 1965 (Dept. Agr. Port Moresby).

Additional material. One, Murray Pass, **Papua**, 2400–2800 m, Nov. 6, 1965 (Sedlaceks); 1 ♂, Camp E. of Mt. Wilhelmina, Snow Mts., **West N. G.,** 3600 m, Sept. 1938 (Toxopeus).

Measured specimens. The ♂ holotype and 1 ♀ paratype from Mt. Wilhelm.

Notes. This geographically isolated *Chydaeus* is similar to *obscurus* Chaudoir (of Sikkim, etc.) but has a slightly wider head and differs in other details.

The Snow Mts. specimen may represent an independent population, distinguished by wider prothorax and perhaps by other characters, but more material is necessary to decide this.

Genus *PLATYMETOPUS* Dejean

Dejean 1929, Species Général Coléop. 4, p. 68.
Csiki 1932, Coleop. Cat., Carabidae, Harpalinae 6, p. 1205 (see for synonymy and additional references).
Schauberger 1938, Arbeiten morphologische und taxonomische Ent. 5, p. 41 (see for comments on some species of the Malay Archipelago).
Basilewsky 1950, Ann. Mus. Congo Belge (8), Zool., 6, p. 141.

Diagnosis. Medium-sized, dull black Harpalini distinguished from all other members of the tribe in New Guinea by dorsal surface entirely coarsely punctate and pubescent.

Description. None required here.

Type species. P. vestitus Dejean, of Africa.

Generic distribution. **Africa**, the **Cape Verde Islands**, and **Madagascar**; **SE. Asia**, **Japan**, and the **Malay Archipelago** to the **Philippines** and **New Guinea** (not Australia).

Notes. A single widely distributed species of this genus reaches New Guinea.

Platymetopus laticeps Dejean

Dejean 1829, Species Général Coléop. 4, p. 76.
Csiki 1932, Coleop. Cat., Carabidae, Harpalinae 6, p. 1206 (see for additional references and for "varieties").

Description. None required here. See *Diagnosis* of genus. Length *c.* 8 mm.

Type(s). From the **Philippines**; in Oberthür Coll., Paris Mus. (not seen).

Occurrence in New Guinea. Collected only in the western part of **West N. G.**: 4, Biak Is., dates in Jan., Feb., Mar., Apr. 1952 (L. D. Brongersma, Leiden Mus.), at light; 2, Wong R., Feb. 9, 1957 (R. T. Simon Thomas, Louwerens Coll.), at light; 1, Sorong-Doom, Feb. 9, 1957 (R. T. Simon Thomas, Louwerens Coll.), at light.

Notes. Closely related forms of this genus, some treated as varieties of *Platymetopus flavilabris* (Fabricius) by Csiki, are widely distributed in SE. Asia and the Malay Archipelago. Their taxonomy is a problem. The problem, however, lies mainly in the Oriental Region rather than New Guinea, and I cannot undertake to solve it now.

Whatever the final taxonomic arrangement, it seems clear that one, dark-legged form of *Platymetopus* (all surely New Guinean individuals are dark-legged) has reached New Guinea recently from the west and may perhaps still be confined to the western end of the island. Its absence elsewhere in New Guinea is suggested by the facts that members of this genus are usually common where they occur at all and that they fly to light, but that none has been found in light trap material from central and eastern New Guinea. *P. laticeps* has been previously known from **Buru** (specimen in Andrewes Coll.) and the **Philippines.**

Besides the dark-legged individuals recorded above, I have seen two yellow-legged ones labeled "Dory" and "Dorey." They were probably collected by Wallace and are presumably really from Celebes (see Part I of the present work, pp. 330–331). They are probably referable to *P. subrugosus* Schauberger (see reference cited under genus, above) of Celebes. This species should *not* be listed from New Guinea.

Genus *TRICHOTICHNUS* Morawitz

Morawitz 1863, Mem. Acad. Sci. St. Petersburg (7) 6, No. 3, p. 63.
Csiki 1932, Coleop. Cat., Carabidae, Harpalinae 6, pp. 1210, 1217 (see for additional references, subgenera, and synonymy).
Basilewsky 1950, Ann. Mus. Congo Belge, Zool. 6, p. 87.

Diagnosis. See *Key to Genera of Harpalini of New Guinea.*

Description (important characters shared by New Guinean species). Form of ordinary, medium-sized Harpalini; upper surface not pubescent. *Head* smooth except for deep, oblique, usually linear frontal impressions; 1 seta over each eye; mentum toothed; labial palpi with penultimate segments with more than 2 setae. *Prothorax* subcordate or transverse; side margins each with 1 seta-bearing puncture, before middle; disc usually extensively punctate especially across base, with punctation finer and usually sparser across middle. *Elytra* with striae entire, impressed, impunctate; 3rd intervals 1-punctate near inner edge at or slightly behind middle (punctures sometimes obscured or absent on one or both elytra). *Inner wings* usually full, rarely dimorphic (some populations of *nigricans* and *altus*). *Lower surface*: prosternum anteriorly with short pubescence (reduced in *medius*). *Legs*: front tibiae with apex less than ¼ wide as tibial length; hind tarsi moderate or long. *Secondary sexual characters*: ♂ front and usually middle tarsi 2-seriately squamulose; 2 setae each side last ventral segment in both sexes. See also *Notes*, below.

Type species. *T. longitarsis* Morawitz, of Japan.

Generic distribution. Temperate and tropical **Eurasia** and the **Malay Archipelago** to **New Guinea**, etc. (probably not Australia); **eastern North America**. The genus in a broad sense, including *Hyparpalus*, occurs also in Africa (Csiki, probably following Schauberger), but Basilewsky considers *Hyparpalus* a separate genus and does not recognize *Trichotichnus* in Africa south of the Sahara.

Notes. I have had difficulty with both the generic and the specific classifications of the 15 New Guinean species that I now assign to this genus. Several of the species might go in *Lampetes* (*Lamprophonus*) or *Carbanus*, but I have not found satisfactory characters to distinguish these genera from *Trichotichnus*. However, I do *not* intend to reduce them to synonymy now. They need further study based on Oriental as well as New Guinean forms. This study will require more time and material than I now have.

The descriptions of species in the following pages are brief, and allowance must be made for individual variation, which is surprisingly great in some characters. For example, the punctation of the outer elytral intervals is variable in some cases (e.g., in *mixtus*). The form of the elytral apices is sometimes variable (e.g., in *denarius* and *altus*). And the form of the apex of the aedeagus is surprisingly variable in some species. I have figured it in some cases but have usually not used it as a diagnostic character. But see under *altus* and *dux* (Figs. 172, 173).

All New Guinean species of *Trichotichnus* are fully winged and probably capable of flight (some of them have been taken in light traps), with 2 exceptions. *T. nigricans*, although apparently always fully winged at low altitudes, is dimorphically winged on the Bismarck Range. And some populations of *T. altus* include individuals with slightly shortened and weakened wings, although other individuals of this species fly. Some *Trichotichnus* in other parts of the world have atrophied or dimorphic wings.

Most or all of the common, unspotted *Trichotichnus* in New Guinea probably live on the ground in rain forest, but I did not distinguish the different species in the field and cannot be sure of their exact habitats.

The following *Key to Species of Trichotichnus of New Guinea* works reasonably well for series of clean specimens, but it is not perfect. I myself have had trouble placing some single specimens. In order to simplify identifications and reduce need for using the key, I give the following notes for recognizing several of the commoner, *dark* (unmarked) species.

If large (7.3–8.3 mm), rufo-piceous, shining, and *without pubescence at front of prosternum* (but some setae at apex of

prosternal process): see *Lyter*, second genus after *Trichotichnus*.

If large (8–9 mm), broad, and *with partial raised 10th intervals in elytral margins: denarius.*

If large (*c.* 8–10 mm), less broad, without raised 10th intervals, and *found at considerable elevations in mountains* (usually over 1200 m): probably *altus.*

If small (6.5–7.5 mm), dark, and without reticulate microsculpture on elytral intervals: probably *nigricans.*

If small (6.3–7.0 mm), dark, and *with reticulate microsculpture on elytral intervals*: probably *semimas* (which lacks squamules on ♂ middle tarsi).

Key to Species of *Trichotichnus* of New Guinea

1. Head *c.* ⅔ width prothorax (H/P 0.66 and 0.68); prothorax transverse with broadly rounded sides; length 5.0–6.3 mm (p. 50) ..... *straneoi*
– Head *c.* ¾ or more width prothorax (by measurement); prothorax more subcordate; usually larger 2
2. Elytra with partial raised 10th intervals in marginal channels; (no dorsal markings; length 8–9 mm) (p. 51) ..... *denarius*
– Elytra without partial raised 10th intervals 3
3. Male with only anterior (not middle) tarsi squamulose; elytral intervals microreticulate; (no dorsal markings; length 6.3–7.0 mm) (p. 52) ..... *semimas*
– Male with middle as well as anterior tarsi with squamules; elytra often (not always) without microreticulation 4
4. Elytra without subapical sutural spot or sutural intervals pale 5
– Elytra with common subapical sutural spot pale, or sutural intervals pale near apex ... 11
5. Prothorax and elytra without pale margins; abdomen usually without *conspicuous* pale spots or margins; femora not *conspicuously* paler than abdomen 6
– Prothorax and elytra usually with narrow pale margins; abdomen usually with conspicuous pale lateral spots or margins; femora *conspicuously* pale 10
6. Length 6.5–7.5 mm; pronotum not much depressed at sides toward base; (basal margin of pronotum usually incomplete) (p. 52) ..... *nigricans*
– Larger, *or* sides of pronotum more depressed toward base 7
7. Eyes slightly larger, separated from mouth below by *c.* ⅛ diameter of an eye; apex of aedeagus short; (length *c.* 8–10 mm) (p. 53) ..... *modus*
– Eyes slightly smaller, more distant from mouth below; apex of aedeagus longer, slender 8
8. Length 11.5–13.0 mm (p. 53) ..... *dux*
– Length 7.2–10.0 mm 9
9. Prosternal pubescence more abundant; size usually larger (*c.* 8–10 mm); pronotum more punctate, less shining (p. 54) ..... *altus*
– Prosternal pubescence usually scanty, but variable; size usually smaller (7.2–8.5 mm); pronotum less punctate, more shining; (direct comparison necessary to determine some specimens) (p. 55) ..... *medius*
10. Elytral intervals not obviously microreticulate; abdomen with pale spots usually largest and most conspicuous at sides of subapical segment; (length 8.3–9.3 mm) (p. 56) ..... *brandti*
– Elytral intervals microreticulate; abdomen usually more extensively pale margined; (length 8.5–9.4 mm) (p. 56) ..... *obscurus*
11. Length usually 7.6–8.5 mm (rarely slightly smaller); subapical sutural pale spot distinct, reaching 3rd intervals (p. 57) ..... *guttula*
– Smaller; sutural pale spot variable, sometimes smaller or less distinct 12
12. Prothorax wide at base (base/apex 1.34); (length 7.5 mm) (p. 57) ..... *mongi*
– Prothorax narrower at base 13
13. Sides of elytra (intervals 8, 9) rugose-punctate; (length 5.3–6.8 mm) (p. 58) ..... *semirugosus*
– Sides of elytra not rugose, although sometimes punctulate 14
14. Length 5.8–7.5 mm; pronotum depressed at sides toward base; (and see *Notes* under this species) (p. 58) ..... *mixtus*
– Length 5.3–5.8 mm; sides of pronotum scarcely depressed (p. 59) ..... *delicatus*

Trichotichnus straneoi (Louwerens)

Louwerens 1962, Tijdschrift voor Ent. 105, p. 142, fig. 7 (*Carbanus*).

Description. With characters of genus; small, form (Fig. 20) broad; brownish black, sides of pronotum and elytra vaguely translucent, lower surface and appendages more rufous; elytra faintly iridescent but not distinctly microreticulate (at 50×). *Head* small, 0.66 and 0.68 width prothorax; eyes large, separated from mouth below by

c. 1/12 or less width of an eye. *Prothorax* transverse with broadly rounded sides; width/length 1.59 and 1.59; base/apex 1.41 and 1.39. *Elytra*: width elytra/prothorax—and 1.30. *Secondary sexual characters* normal for *Trichotichnus*. *Measurements* (in New Guinea): length *c.* 5.0–6.3; width *c.* 2.3–2.7 mm.

Types. Holotype ♂ (Louwerens Coll.), allotype, 6 paratypes all from Amboina Island, **Moluccas**, 70 m (A. M. R. Wegner), at light; a paratype now in M.C.Z. (Type No. 31,149) (holotype not seen).

Occurrence in New Guinea. **Papua**: 3, Brown R., May 21, 23, 24, 1956 (E. J. Ford, Jr., Bishop Mus.); 1, Mts. between Agamoia and Ailuluai, Ferguson Is., 900 m, "No. 4," June 5–17, 1956 (L. J. Brass, U.S.N.M.). **N-E. N. G.**: 13, Wau, Morobe Dist., 1200, 1300 m, various dates (Sedlacek); 1, Wantoat, Finisterre Mts., 4000 ft. (1220 m), Sept. 9, 1957 (Monroe and Holland, Canadian Nat. Coll.); 1, Eliptamin Vy., 1350–1665 m, June 23–30, 1959 (W. W. Brandt, Bishop Mus.). **West N. G.**: 1, Hollandia, July–Sept. 1944 (Darlington); 1, Cyclops Mts., Sabron, 2000 ft. (610 m), June 1936 (Cheesman); 1, Hollandia area, W. Sentani, Cyclops Mts., 50–100 m, June 22–24, 1959 (Gressitt & T. C. Maa, Bishop Mus.), in light trap; 2, Star Rge., Sibil, 1260 m, May 16, June 16, 1959 (Leiden Mus.), at light.

Measured specimens. A pair (♂ ♀) from Brown R.

Notes. Andrewes placed *Carbanus* in the wrong subtribe of Harpalini, erroneously considering it a member of the Acupalpina. The arrangement of setae on the labial palpi seems to me to place it with the Harpalina, and I can find no positive character to distinguish it from *Trichotichnus*. However, I do not intend to synonymize *Carbanus* now. It requires further study. The name can be used for a group of small, mutually similar species (*lautus* Andrewes of Burma, *flavipes* Andrewes of Java, *philippinus* Jedlicka of the Philippines, and *straneoi* Louwerens of the Moluccas, New Guinea, etc.) that may eventually be separated from *Trichotichnus*.

T. straneoi extends to **New Britain** and **New Ireland** (specimens in Bishop Mus.). Nothing is recorded of its habitat or habits except that it flies to light.

Trichotichnus denarius n. sp.

Description. With characters of genus; form slightly broader than usual; black or piceous, appendages browner, sides of abdomen with small pale marks (variable); rather shining, most of upper surface without visible microreticulation (at 50×) but elytra silky in some lights. *Head* 0.77 and 0.77 width prothorax; eyes large, separated from mouth below by *c.* 1/6 diameter of an eye. *Prothorax* transverse-subcordate; width/length 1.59 and 1.63; base/apex 1.14 and 1.10; sides converging and usually broadly and slightly sinuate before distinct but obtuse posterior angles; basal marginal line fine or interrupted at middle; disc weakly convex, moderately depressed at sides especially posteriorly, extensively punctate but with punctation finer and slightly sparser at middle. *Elytra* broad; width elytra/prothorax 1.36 and 1.36; marginal gutters wider than usual, with irregular raised 10th intervals in *c.* middle 1/3 of length; apices usually slightly dehiscent and *c.* pointed, but variable; outer intervals (8, 9, and 10) usually slightly, finely punctulate. *Secondary sexual characters* as for genus. *Measurements*: length *c.* 8.0–9.0; width 3.3–3.8 mm.

Types. Holotype ♂ (M.C.Z., Type No. 31,366) and 111 paratypes from Dobodura, **Papua**, Mar.–July 1944 (Darlington); and additional paratypes as follows. **Papua**: 20, Kokoda, 1200 ft. (366 m), June, July, Aug., Sept., Oct. 1933 (Cheesman); 1, same locality, Mar. 28–29, 1956 (Gressitt); 2, Biniguni, Gwariu R., 150 m, "No. 3," July 27–Aug. 14, 1953 (Geoffrey M. Tate, A.M.N.H.); 5, Peria Ck., Kwagira R., 50 m, "No. 7," Aug. 14–Sept. 6, 1953 (Geoffrey M. Tate, A.M.N.H.); 1, Kokoda-Pitoki, 400 m, Mar. 23, 1956 (Gressitt). **N-E. N. G.**:

3, lower Busu R., Huon Pen., May 4, 1955 (E. O. Wilson, M.C.Z.), in lowland rain forest; 1, Simbang, Huon Gulf, 1899 (Biró). **West N. G.**: 1, Wamoro (ex Coll. G. Hauser, British Mus.).

Measured specimens. The ♂ holotype and 1 ♀ paratype from Dobodura.

Notes. The partial 10th intervals in the elytral margins immediately distinguish *denarius*. The species is very common in eastern New Guinea (apparently much less so in the west), presumably in rain forest. One of Miss Cheesman's specimens was taken at light and so apparently were the Peria Creek individuals, which have scales and wing fragments of other insects on them.

Trichotichnus semimas n. sp.

Description. With characters of genus; form rather slender; black or piceous, appendages brown, abdomen with some (variable) small pale marks at sides; moderately shining but elytra with transverse microreticulation distinct at 50×. *Head* 0.79 and 0.79 width prothorax; eyes moderate, separated from mouth below by nearly ¼ diameter of an eye. *Prothorax* subcordate; width/length 1.48 and 1.48; base/apex 1.18 and 1.16; sides rounded anteriorly, converging and sinuate before distinct *c.* right (slightly obtuse) posterior angles; basal marginal line faint or interrupted at middle; disc very little depressed at sides toward base, extensively punctate except almost impunctate at middle. *Elytra* normal; width elytra/prothorax 1.23 and 1.26; outer intervals not distinctly punctulate. *Secondary sexual characters* normal except only front (not middle) tarsi of ♂ squamulose. *Measurements*: length 6.3–7.0; width 2.5–2.8 mm.

Types. Holotype ♂ (M.C.Z., Type No. 31,367) and 19 paratypes from Dobodura, **Papua**, Mar.–July 1944 (Darlington); 4 paratypes, Kokoda, **Papua**, 1200 ft. (366 m), Oct., Sept. 1933 (Cheesman); 3 paratypes, same locality, Mar. 20, 28–29, 1956 (Gressitt), in light trap; 2, Normanby Is., Wakaiuna, Sewa Bay, Nov. 1–10, 1956 and Jan. 1–8, 1957 (W. W. Brandt, Bishop Mus.). **N-E. N. G.**: 1, Erima, Astrolabe Bay, 1896 (Biró); 2, Madang ("Friedrich-Wilh.-hafen"), 1901 (Biró); 1, Bulolo, 730 m, Aug. 27, 1956 (E. J. Ford, Jr., Bishop Mus.), in light trap; 1, Sum-Sum, 64 km N. of Wau, 580 m, Feb. 15, 1963 (Sedlacek). **West N. G.**: 4, Hollandia area, W. Sentani, Cyclops Mts., 50–100, 100, 150–250 m, June (various dates) 1959 (Gressitt and T. C. Maa, Bishop Mus.); 2, Ifar, Cyclops Mts., 450–500, 400–800 m, Sept. 7, 7–9, 1962 (Sedlacek); 3, Dojo, Res. Hollandia, Apr. 1957, 1958 (R. T. Simon Thomas, in Louwerens Coll.); 1, Maffin Bay, Aug. 1944 (E. S. Ross, California Acad.); 1, Wasian, Vogelkop, Sept. 1939 (Wind, M.C.Z.).

Measured specimens. The ♂ holotype and 1 ♀ paratype from Dobodura.

Notes. Males of *semimas* are unique among New Guinean *Trichotichnus* in lacking the usual sexual squamules of the middle tarsi. Females resemble *nigricans* (below) but differ by presence of reticulate microsculpture on the elytra. *T. semimas* probably lives in rain forest, and has been taken at light near Hollandia as well as at Kokoda.

Trichotichnus nigricans Schauberger

Schauberger 1935, Ent. Anzeiger 15, p. 34.

Description. With characters of genus; form rather small and slender; black, appendages brownish, sides of abdomen with or without small, often vague pale marks; upper surface including elytra without distinct reticulate microsculpture. *Head* 0.76 and 0.75 width prothorax; eyes usually moderate and separated from mouth below by *c.* ⅓ diameter of an eye, but eyes smaller and more distant from mouth in short-winged individuals from Bismarck Range. *Prothorax* subcordate, with sides slightly or not sinuate before usually well defined but obtuse basal angles; width/length 1.43 and 1.49; base/apex 1.21 and 1.18; basal marginal line usually incomplete at middle;

disc only slightly depressed at sides basally, extensively punctate, punctation finer and sparser at middle. *Elytra* normal; width elytra/prothorax 1.27 and 1.25; outer intervals not distinctly punctulate. *Wings* full in lowland populations, dimorphic on Bismarck Range (see *Notes*, below). *Secondary sexual characters* normal. *Measurements*: length *c.* 6.5–7.5; width *c.* 2.5–2.8 mm.

Types. (Holo)type (Andrewes Coll., British Mus.) and 2 "cotypes" all from Sattelberg, **N-E. N. G.** (G. Hauser). I saw the type in London in 1948 and made a satisfactory comparison with it.

Occurrence in New Guinea. Common and widely distributed: 180 specimens from localities well distributed over **New Guinea** and on Woodlark and Normanby Is.; most from low altitudes, but series from Chimbu Vy., Bismarck Rge., between 5000 and 7000 ft. (*c.* 1500–2100 m), and from Wau, 1200 m. Specimens taken in every month.

Measured specimens. A pair (♂ ♀) from Dobodura, Papua.

Notes. T. nigricans occurs also on ***New Britain***, and related forms, compared by Schauberger (1935, p. 36), are known from Java, Sumatra, and Celebes.

This species probably occurs in rain forest, although the Chimbu specimens were taken in open country.

I have not examined the wings of every specimen, but all or most of those from low altitudes are winged, and they often fly. They have been taken in light traps at several localities. However, of my Chimbu series, only 3 specimens (both sexes) have full wings, and 11 (both sexes) have the wings reduced to thin strips *c.* ½ as long as the elytra. I have not examined the wings of the 41 specimens from Wau because some or all were collected in light traps, which would select only winged individuals.

Besides the 180 specimens that I assign to this species without much doubt, 7 specimens from various localities in New Guinea are assigned doubtfully, because of slight differences in various characters.

Trichotichnus modus n. sp.

Description. With characters of genus; form (Fig. 21) average, somewhat variable (see proportions); black, legs brownish, abdomen ± brownish (apical segment darker) with lateral pale areas absent or not sharply defined; shining, elytra subiridescent but without visible reticulate microsculpture. *Head* 0.72 and 0.76 width prothorax; eyes slightly larger than usual, separated from mouth below by *c.* ⅛ diameter of an eye. *Prothorax* transverse-subcordate; width/length 1.43 and 1.53; base/apex 1.30 and 1.20; sides rounded anteriorly, converging and usually slightly sinuate before well defined but obtuse posterior angles; basal marginal line faint or incomplete at middle; disc moderately depressed at sides, extensively punctate except *c.* impunctate at middle. *Elytra*: width elytra/prothorax 1.32 and 1.36; marginal channels narrow, without 10th intervals; outer intervals not distinctly punctulate. *Secondary sexual characters* normal; apex aedeagus short, ± hooked dorsally. *Measurements*: length 8.0–10.0; width 3.4–3.9 mm.

Types. Holotype ♂ (M.C.Z., Type No. 31,368) and 6 paratypes all from Dobodura, **Papua**, Mar.–July 1944 (Darlington).

Additional material. **Papua**: 1, Normanby Is., Wakaiuna, Sewa Bay, Jan. 1–8, 1957 (W. W. Brandt, Bishop Mus.). **West N. G.**: 1, Wissel Lakes, Tage L., 1760 m, Aug. 4, 1955 (Gressitt). These specimens are assigned to *modus* doubtfully.

Measured specimens. The ♂ holotype and 1 ♀ paratype.

Notes. This species resembles *denarius* in size and color, but differs by lack of partial 10th elytral intervals.

Trichotichnus dux n. sp.

Description. With characters of genus; form *c.* average, very large; black, appendages dark brown, abdomen without distinct pale areas; upper surface finely microreticulate, meshes *c.* isodiametric on head,

increasingly transverse on pronotum and elytra. *Head* 0.76 and 0.77 width prothorax; eyes separated from mouth below by *c.* ¼ width of an eye (but eyes more deeply covered than usual with transparent window-like material so edges not precisely defined). *Prothorax* subcordate; width/length 1.41 and 1.46; base/apex 1.19 and 1.23; sides rounded anteriorly, converging and straight or slightly sinuate before well defined but obtuse posterior angles; basal and apical marginal lines usually faint or interrupted at middle; disc moderately depressed at sides posteriorly, finely but extensively punctate or punctulate, the punctation strongest basally. *Elytra*: width elytra/prothorax 1.39 and 1.30; margins narrow; outer intervals not distinctly punctulate. *Inner wings* full (see following *Notes*). *Secondary sexual characters* normal; apex aedeagus as in Figure 173. *Measurements*: length 11.5–13.0; width 4.4–5.1 mm.

Types. Holotype ♂ (Bishop Mus.) and 4 paratypes (2 in M.C.Z., Type No. 31,369), from Edie Creek, 14 km SW. of Wau, **N-E. N. G.,** 1900 and 2000 m, Oct. 4–10, 1961, and Feb. 13, 1962 (Sedlacek). Additional paratypes from **N-E. N. G.**: 3, Wau, 1700, 2400 m, Jan. 9–12, Oct. 6, 1962 (Sedlacek); 6, Kepilam, 2400 and 2500 m, June 21, 20–22, 21–23, 1963 (Sedlacek); 1, Tambul, 2200 m, May 27–June 7, 1963 (Sedlacek); 1, Laiagam, W. Highlands, Mar. 23, 1960 (J. H. Barrett, Dept. Agr. Port Moresby), at light; 1, Moke, Okapa Subd(istrict), E. Highlands, 6400 ft. (1950 m), Apr. 17, 1962 (J. H. Barrett, Dept. Agr. Port Moresby). 2, Okapa, June 12, 1964, Jan. 10, 1965 (Hornabrook).

Measured specimens. The ♂ holotype and 1 ♀ paratype from Edie Creek.

Notes. The large size distinguishes this species from all others of the genus in New Guinea. All specimens of the type series are fully winged, but most were taken in light traps which, of course, select winged individuals.

Trichotichnus altus n. sp.

Description. With characters of genus; form of *c.* average large New Guinean *Trichotichnus*; black or piceous, appendages dark brownish, sides of abdomen with indistinct or poorly defined (variable) pale areas; moderately shining, elytra with transverse microreticulation faintly or not visible at 50×. *Head* 0.76 and 0.75 width prothorax; eyes separated from sides of mouth below by *c.* ¼ width of an eye. *Prothorax* subcordate; width/length 1.40 and 1.50; base apex 1.15 and 1.18; sides converging and straight or slightly sinuate before well defined but obtuse posterior angles; disc moderately depressed at sides posteriorly, variably but often extensively punctate, most conspicuously so across base and least so across middle; basal marginal line entire, faint, or interrupted at middle (variable). *Elytra*: width elytra/prothorax 1.25 and 1.31; margins narrow, without 10th intervals; apices pointed or blunted (variable); outer intervals not distinctly punctulate. *Inner wings* dimorphic on the Bismarck Range (type series), full and strong in some individuals, slightly shortened (but still folded at apex) and with slightly weakened venation in other individuals. *Secondary sexual characters* normal; ♂ copulatory organs as in Figure 172. *Measurements*: length 8.0–10.3; width 3.3–3.9 mm.

Types. Holotype ♂ (M.C.Z., Type No. 31,370) and 42 paratypes from Chimbu Vy., Bismarck Rge., **N-E. N. G.,** 5000–7500 ft. (*c.* 1500–2300 m), Oct. 1944 (Darlington); and 16 paratypes, Tomba, S. slope of Mt. Hagen (Bismarck Rge.), 2450 m, May 22–24, 1963 (Sedlacek).

Additional material. See *Notes*, below.

Measured specimens. The ♂ holotype and 1 ♀ paratype from Chimbu Vy.

Notes. T. altus and its allies (*dux*, above, and *medius*, below) are the common mountain-living *Trichotichnus* of New Guinea. These 3 species seem clearly distinct and have different, but in part overlapping, ranges; *dux*, on the mountains of the

Morobe area; typical *altus*, on the Bismarck Range; and typical *medius*, on the Torricelli Mts. However, I have seen many additional specimens of *altus* or closely related forms from other localities, as follows. **Papua**: 9, Mt. Giluwe, 2500 m, May 1 and 27, June 6, 1963 (Sedlacek); 1, Dimifa, SE. of Mt. Giluwe, 2200 m, Oct. 11, 1958 (Gressitt); 1, Owen Stanley Rge., Goilala, Bome, 1950 m, Mar. 8–15, 1958 (W. W. Brandt, Bishop Mus.); 1, Mafulu, 4000 ft. (1220 m), Jan. 1934 (Cheesman). **N-E. N. G.**: 270 specimens (in addition to the type series) from localities including Morobe Dist.; Kratke Mts.; W. Highlands; and (S. of the Markham-Ramu Vy.) Salawaket Rge; Mongi Watershed; and Huon Pen. **West N. G.**: 35 specimens, from localities including the Star Rge.; Wissel Lakes; and Snow Mts. (Top Camp; Iebele Camp; Mist Camp; Baliem Camp). Most specimens are from altitudes of 1200 to 2700 m, but a few, from within 200 m of sea level. Individuals have been taken in every month. Most specimens are in the British Mus., Bishop Mus., A.M.N.H., Leiden Mus., C.S.I.R.O. Coll., and M.C.Z.

I have restricted the type series of *altus* and its close relatives to specimens from single localities or restricted areas because the species of this group obviously vary geographically as well as individually. In general, specimens from north of the Markham-Ramu Valley average larger, those from south of the valley smaller, except that some specimens from Wau are as small as some of the types of *medius*. Two distinct forms, a very large one (*dux*) and a smaller one (tentatively referred to *altus*), occur at Edie Creek, showing that the species of this group are not entirely allopatric. The characters, variation, and distribution of these species need more study than I can give them now.

T. altus is known to have dimorphic wings (see *Description*) only on the Bismarck Range. The specimens in question were not collected at light. Much of the other material listed above was taken in light traps, and such material usually includes only fully winged individuals and is not satisfactory for study of wing dimorphism. This is another reason for not attempting a more detailed study of *altus* and related species with the material available now.

Trichotichnus medius n. sp.

Description. With characters of genus; form average; black, appendages brownish testaceous, abdomen with or without poorly defined pale lateral areas (variable), hind femora not *strikingly* paler than abdomen, tibiae paler than femora; shining, elytra not visibly microreticulate at 50×. *Head* 0.78 and 0.79 width prothorax; eyes separated from mouth below by ¼ or ⅓ diameter of an eye. *Prothorax* subcordate; width/length 1.49 and 1.52; base/apex 1.18 and 1.14; sides converging and straight or slightly sinuate before well defined but obtuse basal angles; fine basal marginal line usually complete; disc moderately depressed at sides basally, extensively punctate across base, punctation much finer and somewhat sparser across middle and anteriorly. *Elytra*: width elytra/prothorax 1.31 and 1.26; margins without 10th intervals; outer intervals not distinctly punctulate. *Inner wings* full. *Lower surface*: *anterior* part of prosternum with pubescence usually sparse (but variable). *Secondary sexual characters* normal. *Measurements*: length *c.* 7.5–8.5; width 3.1–3.3 mm.

Types. Holotype ♂ (Bishop Mus.) and 22 paratypes (some in M.C.Z., Type No. 31,371) from Mokai Village, Torricelli Mts., **N-E. N. G.**, 750 m, various dates in Dec. 1958 and Jan. 1959 (holotype, Jan. 1–23, 1959) (W. W. Brandt); and additional paratypes, all from Torricelli Mts., as follows: 19, Mobitei, 750 m, dates in Feb., Mar., Apr. 1959 (W. W. Brandt, Bishop Mus.); 3, Wantipi, Nov. 30–Dec. 8, 1958 (W. W. Brandt, Bishop Mus.).

Additional material. Some specimens among those summarized under *Trichotichnus altus* may prove referable to *medius*,

especially the smaller ones from south of the Markham-Ramu Valley and from Wau.

Measured specimens. The ♂ holotype and 1 ♀ paratype from Mokai.

Notes. This species is difficult to define exactly. It is larger than *nigricans*, with basal marginal line of pronotum usually entire (usually interrupted in *nigricans*). It is smaller than *modus* and *altus*, with eyes intermediate in size. The sparseness of pubescence on the anterior part of the prosternum is an aid in identification, but it is not infallible. This species is more shining than most *Trichotichnus*, and approaches *Lyter* (p. 63) in appearance, but the clothing of the male front and middle tarsi of *medius* consists of 2 rows of broad scales as usual in *Trichotichnus*. Nevertheless, a *Trichotichnus* like the present one may have been ancestral to *Lyter*.

Trichotichnus brandti n. sp.

Description. With characters of genus; form average; black or piceous, not marked above except lateral margins of elytra and sometimes of prothorax narrowly inconspicuously rufescent or translucent; reddish piceous below with epipleurae and narrow margin of abdomen paler, the pale marks usually widest and most conspicuous at sides of subapical ventral segment; appendages brownish testaceous, femora conspicuously paler than abdomen; shining, elytra without distinct reticulate microsculpture. *Head* 0.75 and 0.76 width prothorax; eyes separated from mouth below by about ⅙ diameter of an eye. *Prothorax* transverse-subcordate; width/length 1.43 and 1.45; base/apex 1.20 and 1.21; sides converging and straight or slightly sinuate before obtuse but well formed (sometimes slightly blunted) basal angles; disc depressed at sides near base, extensively punctate, least so near middle; basal marginal line faint or interrupted at middle. *Elytra*: width elytra/prothorax 1.36 and 1.38; 8th and 9th intervals usually with a little sparse, fine punctulation. *Secondary sexual characters* normal. *Measurements*: length 8.3–9.3; width 3.4–3.8 mm.

Types. Holotype ♂ (Bishop Mus.) and 3 paratypes (2 in M.C.Z., Type No. 31,372) from Feramin, **N-E. N. G.**, 1200–1500 m, May 11–22 (holotype), 23–31, 1959 (W. W. Brandt); and additional paratypes as follows, all from **N-E. N. G.**: 3, Torricelli Mts., Mobitei, 750 m, Mar. 16–31, Apr. 1–15, 16–22, 1959 (W. W. Brandt, Bishop Mus.); 2, Eliptamin Vy., 1665–2530 m, June 23–30, and 2, same locality, 1200–1350 m, Aug. 16–30 and Sept. 1–15, 1959 (W. W. Brandt, Bishop Mus.); 15, Wau, Morobe Dist., 1100, 1200 (most), 1300, and 1700–1800 m, Mar., Apr., and all months from June to Dec., 1961–1963 (Sedlacek).

Additional material. The following additional specimens are tentatively assigned to this species. **Papua**: 1, Dogon, Amazon Bay Dist., 2400 ft. (*c.* 730 m), Sept. 1962 (W. W. Brandt, C.S.I.R.O.); 1, Kokoda, 1200 ft. (366 m), July 1933 (Cheesman), at light. **N-E. N. G.**: 1, Tuwep, Salawaket Rge., 1350 m, Sept. 9, 1956 (E. J. Ford, Jr., Bishop Mus.), in light trap. **West N. G.**: 1, Cyclops Mts., Sabron Camp 2, 2000 ft., June 1936 (Cheesman); 1, "Neth. New Guinea" without further locality, Oct. 20, 1944 (T. Aarons, California Acad.).

Measured specimens. The ♂ holotype and 1 ♀ paratype from Feramin.

Notes. See under following species (*obscurus*).

Trichotichnus obscurus n. sp.

Description. With characters of genus; form broad-average; brownish piceous, lateral margins of prothorax and elytra vaguely paler or translucent; abdomen broadly margined with yellow, the yellow margins widest anteriorly; appendages testaceous, hind femora strikingly pale; moderately shining, elytra with transverse reticulate microsculpture visible in both sexes (at 50×). *Head* 0.77 and 0.76 width prothorax; eyes separated from mouth below by ¼ or less width of an eye. *Prothorax* trans-

verse-subcordate; width/length 1.40 and 1.44; base/apex 1.21 and 1.20; sides converging, slightly, broadly sinuate before distinct but obtuse posterior angles; disc moderately depressed at sides basally, extensively but rather finely punctate except almost impunctate at middle. *Elytra*: width elytra/prothorax 1.34 and 1.27; 8th and 9th intervals usually not distinctly punctulate. *Secondary sexual characters* normal. *Measurements*: length 8.5–9.4; width 3.3–3.7 mm.

Types. Holotype ♂ (Bishop Mus.) and 2 paratypes (1 in M.C.Z., Type No. 31,373) from Saidor, Matoko, Finisterre Rge., **N-E. N. G.,** Aug. 29–Sept. 5 and Sept. 6–24, 1958 (W. W. Brandt); and additional paratypes as follows: **Papua**: 1, S. Highlands, Dimifa, SE. of Mt. Giluwe, 2200 m, Oct. 11, 1958 (Gressitt). **N-E. N. G.**: 2, Wau, Morobe Dist., 1200 m, Nov. 1–20 and Dec. 1961 (Sedlacek); 7, Edie Creek, 14 km SW. of Wau, 2000 m, Feb. 13, 1962 (Sedlacek); 1, Eliptamin Vy., 1200–1350 m, Aug. 1–15, 1959 (W. W. Brandt, Bishop Mus.).

Measured specimens. The ♂ holotype and 1 ♀ paratype from Saidor.

Notes. Although this species is superficially similar to the preceding one (*brandti*), I think it is distinct, differing most obviously by presence of elytral microsculpture. The 8th and 9th elytral intervals are usually less punctulate in *obscurus* than in *brandti*.

Trichotichnus guttula n. sp.

Description. With characters of genus; form average; brownish black above, sides of elytra (and to some extent of prothorax) testaceous, elytra with a conspicuous common testaceous subapical sutural spot (reaching 3rd intervals), abdomen either with irregular broad testaceous margins or wholly rufescent, appendages brownish testaceous; moderately shining, elytra usually with distinct transverse microreticulation. *Head* 0.78 and 0.79 width prothorax; eyes large, separated from mouth below by *c.* ⅛ width of an eye. *Prothorax* subtransverse; width/length 1.48 and 1.43; base/apex 1.19 and 1.21; sides rounded anteriorly, converging and nearly straight or slightly sinuate before obtuse but well defined basal angles; disc depressed at sides basally; basal marginal line usually indistinct at middle; surface of disc extensively punctate, the punctation finer and less dense at middle. *Elytra*: width elytra/prothorax 1.32 and 1.33; 8th and 9th intervals not or not much punctulate. *Secondary sexual characters* normal. *Measurements*: length 7.6–8.7; width 3.1–3.6 mm.

Types. Holotype ♂ (Bishop Mus.) and 31 paratypes (some in M.C.Z., Type No. 31,374) from Wau, Morobe Dist., **N-E. N. G.,** 1200 m, Feb., Mar., June, Aug., Sept., Oct., Nov., Dec. 1961–1963 (Sedlaceks); 1 paratype, same locality, 1700–1800 m, Nov. 17, 1961 (Sedlacek).

Additional material. Twenty-four specimens from 13 widely scattered localities including Dobodura, in all 3 political divisions of **New Guinea**; altitudes, near sea level to *c.* 2000 m. Specimens taken in every month except May and June.

Measured specimens. The ♂ holotype and 1 ♀ paratype from Wau.

Notes. This species is characterized by its size plus presence of a conspicuous pale subapical sutural spot. It is apparently widely distributed especially in the foothills and lower mountains of New Guinea. Specimens of this or a closely related species have been seen also from **New Britain** and **New Ireland** (Bishop Mus.).

Trichotichnus mongi n. sp.

Description. With characters of genus; form as in Figure 22, differing from other *Trichotichnus* by subquadrate prothorax, strongly narrowed anteriorly; piceous, lateral margins of prothorax and elytra narrowly translucent or pale, sutural intervals reddish toward apex; shining, elytra subiridescent, without distinct reticulate microsculpture. *Head* 0.72 width prothorax; eyes rather small, separated from mouth below by more than ¼ width of an eye.

Prothorax subquadrate except strongly narrowed at extreme front; width/length 1.40; base/apex 1.35; sides rounded anteriorly, broadly sinuate before *c.* right (slightly obtuse) basal angles; basal marginal line fine but entire; disc scarcely depressed at sides, extensively punctate, the punctures finer and less dense across middle. *Elytra* convex (more so than usual); width elytra/prothorax 1.46; outer intervals with a little sparse punctulation. *Secondary sexual characters* of ♀ normal; ♂ unknown. *Measurements*: length *c.* 7.5; width 3.3 mm.

Type. Holotype ♀ (M.C.Z., Type No. 31,375) from Tumnang, Mongi Watershed, Huon Pen., **N-E. N. G.,** 1400–1600 m, Apr. 14–15, 1955 (E. O. Wilson); the type is unique.

Notes. The unique form of this species makes it worth describing, even though I have only one specimen of it and do not know the male.

Trichotichnus semirugosus n. sp.

Description. With characters of genus; form *c.* average, small; brownish piceous, margins of prothorax and elytra narrowly testaceous, elytra with common subapical sutural pale spot usually reaching 3rd intervals; lower surface in part dark but with extensive, irregular testaceous areas; antennae brownish, legs brownish testaceous; rather shining, elytra usually with faint transverse microreticulation. *Head* 0.81 and 0.84 width prothorax; eyes rather large, separated from mouth below by *c.* ⅛ width of an eye. *Prothorax* subcordate; width length 1.51 and 1.48; base/apex 1.12 and 1.16; sides broadly rounded anteriorly, converging and straight or nearly so posteriorly; posterior angles distinct but obtuse, sometimes minutely denticulate; base more oblique at sides than usual, not or indistinctly margined; disc weakly depressed at sides, extensively punctate, the punctation finer and less dense across middle. *Elytra*: width elytra/prothorax 1.39 and 1.44; 8th and 9th intervals rugosely punctate, punctation present but less dense at bases of 6th and 7th intervals. *Secondary sexual characters* normal. *Measurements*: length 5.3–6.8; width 2.3–2.8 mm.

Types. Holotype ♀ (M.C.Z., Type No. 31,376) and 2 (♀ ♀) paratypes from Dobodura, **Papua**, Mar.–July 1944 (Darlington); and additional paratypes as follows: **N-E. N. G.**: 1, Wau, 1200 m, Nov. 21, 1961 (Sedlaceks); 7, Finschhafen, Huon Pen., 10 m, Apr. 9–16, 1963 (Sedlacek), in mercury vapor light trap; 3, Torricelli Mts., Mobitei, 750 m, Feb. 28–Mar. 4, Mar. 16–31, 1959 (W. W. Brandt, Bishop Mus.). **West N. G.**: 1, Cyclops Mts. (no further details) (Cheesman); 2, Hollandia area, W. Sentani, Cyclops Mts., 50–100 m, June 22–24, 1959 (Gressitt), in light trap; 2, Ifar, Cyclops Mts., 450–500 m, Sept. 7 and 9, 1962 (Sedlacek).

Measured specimens. One ♂ paratype from Mobitei and the ♀ holotype, in this order.

Notes. The coloration and the dense punctation of the elytral margins would place this species in *Lampetes*, if *Lampetes* were distinguished from *Trichotichnus*. The new species is in fact close to *Lampetes isabellinus* Louwerens of Amboina (Tijdschrift voor Ent. 105, 1962, p. 140). However, comparison with paratypes of *isabellinus* shows that *semirugosus* has the outer elytral intervals more completely and more densely rugose, although the difference is not great.

Trichotichnus mixtus n. sp.

Description. With characters of genus; form average, rather small; brownish piceous, lateral margins of prothorax and elytra translucent or pale, and sutural and sometimes 2nd intervals of elytra paler before apex (variable), abdomen broadly but irregularly pale-margined, legs and antennae irregularly brownish testaceous; shining, elytra with or without light transverse microreticulation. *Head* 0.79 and 0.79 width prothorax; eyes rather large, separated from mouth below by *c.* ⅛ diameter of an eye. *Prothorax* transverse-subcordate; width/length

1.54 and 1.54; base/apex 1.15 and 1.13; sides broadly rounded anteriorly, nearly straight and converging posteriorly to obtuse, sometimes slightly blunted posterior angles; basal marginal line usually interrupted at middle; disc depressed at sides basally, extensively punctate, the punctation finer and sparser across middle. *Elytra*: width elytra/prothorax 1.36 and 1.36; 7th and 8th intervals variably punctate (8th varying from almost impunctate to almost rugose); other intervals sparsely or not punctulate. *Secondary sexual characters* normal. *Measurements*: length 5.8–7.5; width 2.8–3.2 mm.

Types. Holotype ♂ (Bishop Mus.) and 4 paratypes (2 in M.C.Z., Type No. 31,377) from Torricelli Mts., Mobitei, **N-E. N. G.,** 750 m, Mar. 5–15, Apr. 16–22 (holotype with latter date), 1959 (W. W. Brandt).

Additional material. Twenty-one specimens from 11 localities (including Wau) in all 3 political divisions of New Guinea are assigned to *mixtus* but not as types. They vary considerably in several characters.

Measured specimens. The ♂ holotype and 1 ♀ paratype.

Notes. Because of the variation of this species (if it is all one species) I have confined the type series to specimens from one locality. In general, the species should be recognizable by size; sutural intervals pale before apex; prothorax usually relatively wide (wider and a little more depressed at sides toward base than in *semirugosus*); and outer elytral intervals usually punctulate but not rugose, although this last character is surprisingly variable even in the type series.

Trichotichnus delicatus n .sp.

Description. With characters of genus; form (Fig. 23) slender-average, very small; brownish piceous, prothorax with margins narrowly pale or translucent, elytra with margins and common subapical sutural spot (including small parts of 2nd intervals) testaceous or rufescent; abdomen with or without well defined pale margins; appendages testaceous; shining, elytra without reticulate microsculpture. *Head* 0.74 and 0.77 width prothorax; eyes moderate, separated from mouth below by *c.* ⅙ or ⅛ width of an eye. *Prothorax* subcordate; width/length 1.50 and 1.44; base/apex 1.11 and 1.21; sides broadly slightly sinuate before obtuse, usually slightly blunted posterior angles; basal marginal line vague or incomplete at middle; disc scarcely depressed at sides even basally, less densely punctate than usual, with middle of disc least punctate. *Elytra*: width elytra/prothorax 1.30 and 1.31; outer intervals without or with only sparse punctulation, *Secondary sexual characters* normal. *Measurements*: length 5.3–5.8; width 2.2–2.4 mm.

Types. Holotype ♀ (Hungarian Nat. Mus.) and 1 ♀ paratype (M.C.Z., Type No. 31,378) from I. Deslacs (Garove Is.), **N-E. N. G.,** 1901 (Biró); and additional paratypes as follows: **Papua**: 1, Woodlark Is. (Murua), Kulumadau Hill, Mar. 9–12, 1957 (W. W. Brandt, Bishop Mus.). **West N. G.**: 1, Hollandia, Dec. 1944 (W. T. Nailon, Fenton Coll.); 1, Res. Hollandia, Dojo, 2nd Strip, July 12, 1957 (R. T. Simon Thomas, Louwerens Coll.).

Measured specimens. A ♂ paratype from Woodlark Is. (the only ♂ of the species seen) and the ♀ holotype, in this order.

Notes. T. delicatus is characterized by small size, markings, and scarcely depressed sides of pronotum.

Genus *HARPALOXENUS* Schauberger

Schauberger 1933, Ent. Anzeiger 13, p. 154.

Diagnosis. Characters as for *Trichotichnus* (preceding genus) except anterior tibiae wider; form characteristic (Fig. 24); upper surface without distinct reticulate microsculpture, but 8th and 9th elytral intervals closely punctulate (except in *fortis*), other intervals sparsely or not punctulate; wings full.

Description. None required here.

Type species. H. javanus Schauberger, of Java.

Generic distribution. **Java** and **Andonare Is., Celebes, Philippines, Moluccas** (Halmahera), **New Guinea**, and (unpublished) **Solomon Islands** and **New Hebrides**.

Notes. The species assigned to this genus seem to form a natural group. However, the group is apparently closely allied to *Trichotichnus* and further study may show that it is not worth generic separation.

KEY TO SPECIES OF *HARPALOXENUS* OF NEW GUINEA

1. Anterior tibiae with apex *c.* ⅓ wide as tibial length; head relatively wider (more than 0.80 width prothorax) 2
– Anterior tibiae with apex *c.* ¼ wide as tibial length; head relatively smaller (usually less than 0.80 width prothorax) 3
2. Male with front but not middle tarsi squamulose (p. 60) *fortis*
– Male with front and middle tarsi squamulose (p. 61) *mas*
3. Larger (length *c.* 11 mm) (p. 62) *wau*
– Smaller (length *c.* 10 mm or less) 4
4. Pronotum with sides usually slightly depressed toward base, base usually more coarsely and extensively punctate, posterior angles usually better defined, and median-lateral setae usually *c.* ¼ of prothoracic length before apex (p. 61) *celebensis*
– Pronotum with sides not depressed, base usually more finely punctate especially at middle of base, posterior angles usually more obtuse, and median-lateral setae usually *c.* ⅓ of prothoracic length before apex (p. 62) *sedlaceki*

Harpaloxenus fortis n. sp.

Description. With characters of genus; form as in Figure 24, heavily built; brownish piceous, lateral margins of pronotum and elytra including 9th intervals ± yellowish, lower surface with extensive yellowish areas especially laterally, appendages brownish testaceous. *Head* wide, 0.88 and 0.85 width prothorax; antennae stout, middle segments scarcely longer than wide. *Prothorax* broadly cordate; width/length 1.57 and 1.58; base/apex 0.93 and 0.99; sides converging and usually broadly but not strongly sinuate before obtuse but distinct basal angles; disc slightly depressed at sides posteriorly, basal impressions weak and irregular, base punctate chiefly toward sides. *Elytra* elongate-quadrate; width elytra/prothorax 1.14 and 1.14; outer intervals (8, 9) less punctulate than usual in genus; 3rd intervals either with or (usually) without minute puncture on inner edge behind middle. *Legs*: front tibiae very wide in both sexes, apex *c.* ⅓ wide as tibial length, and apex usually sinuate-emarginate with outer angle slightly produced; middle tibiae slightly wider and more arcuate than in most other species of genus. *Secondary sexual characters*: ♂ front tarsi slightly dilated, with segments 1 (apex only) to 4 2-seriately squamulose below; middle tarsi not perceptibly dilated and not squamulose. *Measurements*: length 8.5–10.3; width 3.1–3.7 mm.

Types. Holotype ♂ (M.C.Z., Type No. 31,379) and 17 paratypes from Dobodura, **Papua**, Mar.–July 1944 (Darlington); and additional paratypes from **Papua** as follows: 8, Kokoda, 1200 ft. (366 m), May, July, Aug. 1933 (Cheesman); 1, same locality, Mar. 20, 1956 (Gressitt), in light trap; 2, Saputa, near Buna, 1943–44 (R. B. Speiry, Chicago Mus.); 1, Deria, Amazon Bay Dist., Dec. 1962 (W. W. Brandt, C.S.I.R.O.); 1, Mt. Lamington, 1300–1500 ft. (*c.* 400–450 m) (C. T. McNamara, S. Australian Mus.).

Additional material. **West N. G.**: 2, (♀ ♀), Hollandia, Apr. 1945 (B. Malkin, U.S.N.M.); 3 (♀ ♀), Hollandia area, W. Sentani, Cyclops Mts., 50–100, 150–250 m, June 17, 22–24, 1959 (Gressitt and T. C. Maa, Bishop Mus.), 2 of these specimens teneral and taken in light trap; 1 ♀, Kota Nika, Res. Hollandia, Jan. 25, 1956 (R. T. Simon Thomas, Louwerens Coll.); 1 ♀, Wasian, Vogelkop, Sept. 1939 (Wind, M.C.Z.). These specimens unfortunately are all ♀ ♀. They are referred to the present species rather than the following one (*mas*) because the 8th and 9th elytral intervals are almost impunctate.

Measured specimens. The ♂ holotype and 1 ♀ paratype from Dobodura.

Notes. The present species differs from all others known in the genus by absence of squamules on the male middle tarsi. However, I do not think that this justifies making a separate genus or subgenus. This species seems otherwise to be a well characterized *Harpaloxenus*, and it apparently is closely related to the following (*mas*), which has the male middle tarsi normally squamulose.

Harpaloxenus mas n. sp.

Description. With characters of genus; form *c.* as in preceding species (*fortis*) but slightly less heavily built; characters as in preceding species except as follows. *Head* relatively slightly smaller, 0.81 and 0.82 width prothorax. *Prothorax* with sides converging but not or scarcely sinuate posteriorly, and with posterior angles slightly more obtuse; width/length 1.52 and 1.45; base/apex 1.00 and 0.98. *Elytra*: width elytra/prothorax 1.24 and 1.29; outer intervals (8, 9) closely punctulate at least anteriorly, sometimes in part rugose. *Secondary sexual characters*: ♂ front and middle tarsi slightly dilated, 2-seriately squamulose. *Measurements*: length *c.* 9.5–10.5; width 3.5–3.7 mm.

Types. Holotype ♂ (Bishop Mus.) and 3 (♂ ♀ ♀) paratypes (pair in M.C.Z., Type No. 31,380) from Finschhafen, Huon Pen., **N-E. N. G.,** 10 m, Apr. 9–16, 1963 (Sedlacek), in mercury vapor light trap; 1 ♂ paratype, Wau, 1050 m, Nov. 4, 1961 (Sedlacek); 1 ♂ paratype, Hol Maffin, near Sarmi, **West N. G.,** July 18, 1959 (T. C. Maa, Bishop Mus.).

Measured specimens. The ♂ holotype and 1 ♀ paratype from Finschhafen.

Notes. This species resembles the preceding one in width of front tibiae but differs in details of form (slightly narrower head, slightly differently shaped prothorax) and in extensive punctulation of outer elytral intervals. The paratype from Hol Maffin has these intervals less punctulate than in the Finschhafen specimens but still more punctulate than in any *fortis* that I have seen.

Harpaloxenus celebensis Schauberger

Schauberger 1933, Ent. Anzeiger 13, pp. 155, 157.
Louwerens 1953, Verhandlungen Naturforschenden Gesellschaft Basel 64, p. 306.
——— 1956, Treubia 23, p. 222.

Description (for recognition only). Form average, rather variable; prothorax and elytra usually narrowly yellow-margined. *Head* 0.75 and 0.81 width prothorax. *Prothorax* transverse-subcordate; width/length 1.50 and 1.52; base/apex 1.20 and 1.06 (exceptionally variable); sides rather weakly converging, not or only slightly sinuate before distinct but slightly obtuse or blunted posterior angles, with anterior-lateral setae usually *c.* ¼ of prothoracic length from apex. *Elytra*: width elytra/prothorax 1.24 and 1.21; dorsal punctures usually present, on inner edge 3rd intervals against 2nd striae (sometimes absent on one or both elytra). *Legs*: front tibiae with apex *c.* ¼ wide as tibial length. *Secondary sexual characters*: ♂ front and middle tarsi squamulose. *Measurements*: length 8.5–10; width 3.2–3.8 mm.

Type. From **South Celebes**; probably in Schauberger Coll. (not seen).

Occurrence in New Guinea. **Papua**: 7, Dobodura, Mar.–July 1944 (Darlington); 2, Dogon, Amazon Bay Dist., 2400 ft. (c. 740 m), Oct.–Nov. 1962 (W. W. Brandt, C.S.I.R.O.) **N-E. N. G.**: 3, Wau, Morobe Dist, 1200 m, Dec. 18, 1961 (Sedlacek); 1, Finschhafen, 10 m, Apr. 9–16, 1963 (Sedlacek), in light trap; 2, Torricelli Mts., Mobitei, 750 m, Mar. 5–15, 16–31, 1959 (W. W. Brandt, Bishop Mus.). **West N. G.**: 6, Hollandia and vicinity including Cyclops Mts. (various dates and collectors); and 5, doubtfully identified, from localities farther west in West N. G., including Biak Is.

Measured specimens. A pair (♂ ♀) from Dobodura.

Notes. Louwerens records *celebensis* from **Java**, **Sumba**, and **Halmahera**, as

well as **Celebes**, and the present records extend its range to **New Guinea**. However, variation is considerable and I am not sure of my identifications in some cases. Small specimens of this species can be confused with certain *Trichotichnus*, especially with discolored individuals of *guttula*, but the particular *Trichotichnus* in question do not have the 8th and 9th elytral intervals closely punctulate and have, of course, slightly narrower front tibiae. See under the following species (*sedlaceki*) for further comparisons.

Harpaloxenus sedlaceki n. sp.

Description. With characters of genus; form average; black or piceous, sides of pronotum not or vaguely pale, elytra narrowly pale-margined, abdomen pale-spotted at sides, appendages brownish testaceous. *Head* 0.75 and 0.75 width prothorax. *Prothorax* transverse-subquadrate; width/length 1.50 and 1.49; base/apex 1.19 and 1.21; sides moderately converging and nearly straight posteriorly but usually not sinuate, with median-lateral setae usually *c.* ⅓ of prothoracic length before apex; posterior angles obtuse, ± blunted; disc rather strongly almost evenly convex, not depressed at sides posteriorly, baso-lateral impressions slight and poorly defined; base (rather finely) punctate especially at sides. *Elytra*: width elytra/prothorax 1.22 and 1.20; outer intervals (8, 9) extensively closely punctulate; dorsal punctures of 3rd intervals usually *c.* midway between 2nd and 3rd striae (see *Notes*, below). *Legs*: front tibiae with apex *c.* ¼ wide as tibial length. *Secondary sexual characters*: ♂ front and middle tarsi slightly dilated, 2-seriately squamulose. *Measurements*: length 8.0–9.0; width 3.1–3.5 mm.

Types. Holotype ♂ (Bishop Mus.) and 20 paratypes (some in M.C.Z., Type No. 31,381) from Wau, Morobe Dist., 1200 m, **N-E. N. G.**, dates in Apr., Aug., Oct., Nov., Dec. 1961–1963 (Sedlacek).

Additional material. Twenty-two specimens from numerous localities, from Modewa and Dobodura in **Papua** to Hollandia in **West N. G.** Some of these specimens are identified only doubtfully.

Measured specimens. The ♂ holotype and 1 ♀ paratype.

Notes. This species is similar to *celebensis* (above) but differs in having the pronotum slightly more convex with sides usually not at all depressed toward base, and in other ways indicated in the preceding *Key to Species of Harpaloxenus of New Guinea.*

In the types of *sedlaceki* the dorsal puncture of the 3rd interval is usually midway between the 2nd and 3rd striae, not close to the 2nd stria. Of the 21 specimens from Wau, only 1 has the puncture close to the 2nd stria (on the inner edge of the 3rd interval) on both elytra. Two have the puncture close to the 2nd stria on one elytron but near the middle of the 3rd interval on the other. One has the puncture close to the *3rd* stria on one elytron. And 17 have the puncture near the middle of the 3rd interval (but somewhat variable in position) on both elytra. However, this unusual position of dorsal punctures may be characteristic of the local population at Wau rather than of the species as a whole.

Harpaloxenus wau n. sp.

Description. With characters of genus; form nearly as in *celebensis* and *sedlaceki*, but larger; pronotum and elytra not or narrowly and faintly pale-margined, abdomen with irregular testaceous marks at sides, appendages brownish testaceous. *Head* 0.73 and 0.75 width prothorax. *Prothorax* transverse-subquadrate; width/length 1.48 and 1.51; base/apex 1.17 and 1.24; sides slightly converging posteriorly, nearly straight but not sinuate before slightly obtuse-blunted posterior angles; disc usually slightly depressed at sides posteriorly, baso-lateral impressions vague, base finely punctate especially toward sides. *Elytra*: width elytra/prothorax 1.30 and 1.28; outer intervals (8, 9) extensively punctulate; 3rd intervals with dorsal puncture usually by 2nd stria behind middle. *Legs*: front tibiae with apex *c.* ¼ wide as tibial length. *Secondary sexual*

characters: ♂ front and middle tarsi slightly dilated, 2-seriately squamulose. *Measurements*: length *c.* 11; width *c.* 4.2 mm.

Types. Holotype ♂ (Bishop Mus.) and 29 paratypes (some in M.C.Z., Type No. 31,382) from Wau and vicinity, Morobe Dist., **N-E. N. G.,** 1100, 1200 (most), 1700–1800 m, dates in every month, 1961–1964 (Sedlacek).

Measured specimens. The ♂ holotype and 1 ♀ paratype.

Notes. The large size distinguishes this species from other similar ones. As compared with *sedlaceki*, with which it occurs, *wau* is not only larger but has the sides of the pronotum usually slightly depressed toward base and the dorsal puncture of the 3rd intervals usually adjacent to the 2nd stria. Of the 8 types, only 1 has this puncture distant from the 2nd stria on both elytra. Two have the puncture against the 2nd stria on one elytron but distant from it on the other elytron. And 5 have the puncture against or very near the 2nd stria on both elytra.

LYTER n. gen.

Diagnosis. Form and characters of medium-sized *Trichotichnus*, but ♂ front and middle tarsi below with more than 2 rows of long, slender scales forming a loose vestiture (not a dense sole); prosternum glabrous anteriorly; 3rd elytral intervals without or with only faint traces of dorsal punctures.

Description. Head: eyes separated from mouth below by *c.* ⅓ diameter of an eye; antennae rather short, middle segments *c.* 1½× long as wide; front smoothly convex except frontal suture sharply impressed, with impressed lines extending diagonally back to above eyes; mentum with triangular tooth; labial palpi with penultimate segments plurisetose; ligula long, emarginate, 2-setose outside middle of length; paraglossae shorter than ligula. *Prothorax* with 1 lateral seta each side about ¼ prothoracic length from apex. *Elytra*: margins entire at base, obtusely subangulate at humeri, sinuate before apex; marginal channels narrow, without partial 10th intervals; striae entire; scutellar striae long, at base 2nd intervals; 3rd intervals impunctate or with vestige of puncture by 2nd striae behind middle (position as in *Trichotichnus*). *Lower surface*: prosternum glabrous anteriorly but with several setae at apex prosternal process. *Inner wings* full. *Legs*: front tibiae irregularly truncate, apex *c.* ⅕ wide as tibial length, with principal (inner apical) spur not much expanded; hind tarsi with 1st segment 2× or more as long as wide at apex, 5th segment with 2 accessory setae each side. *Secondary sexual characters*: ♂ front tarsi slightly dilated, 4 segments loosely clothed below with slender long scales; middle tarsi scarcely dilated, with some (fewer) similar scales; 2 setae each side last ventral segment in both sexes; ♂ copulatory organs as in Figure 174, with apex of middle lobe not produced beyond orifice.

Type species. Lyter glaber n. sp. (below).

Generic distribution. The single species is confined to **New Guinea**, so far as known.

Notes. The relationships of this new genus are doubtful. It may be derived from an ancestor like *Trichotichnus medius* (p. 55), from which it differs most obviously in the clothing of the ♂ tarsi (2-seriately squamulose in *Trichotichnus*). The new genus is notable also for its relatively long ligula, for absence of pubescence on *anterior* part of prosternum, and for virtual suppression of dorsal elytral punctures.

The name *Lyter*, from the Greek, signifies one who loosens (the squamae of the ♂ front tarsi).

Lyter glaber n. sp.

Description. With characters of genus; form as in Figure 25; reddish piceous, appendages redder; shining, reticulate microsculpture absent on front of head and disc of pronotum, faint and somewhat transverse on elytral intervals. *Head* 0.75 and 0.77 width prothorax. *Prothorax*: width/length

1.45 and 1.49; base/apex 1.12 and 1.16; sides rounded anteriorly, *c.* straight and converging in posterior half, narrowly margined; posterior angles slightly obtuse, blunted; base and apex with or without faint marginal lines; disc slightly depressed at sides basally, the depressed areas finely but not closely punctate. *Elytra*: width elytra/prothorax 1.21 and 1.22. *Measurements*: length 7.3–8.3; width 2.9–3.3 mm.

Types. Holotype ♂ (California Acad.) and 32 paratypes (some in M.C.Z., Type No. 31,383) from Finschhafen, **N-E. N. G.,** various dates in April and May (holotype, May 1) (E. S. Ross); and additional paratypes as follows. **Papua**: 21, Kokoda, 1200 ft. (366 m), Apr., Aug., Sept. 1933 (Cheesman); 1, Owen Stanley Rge., Goilala, Tapini, 975 m, Nov. 16–25, 1957 (W. W. Brandt, Bishop Mus.); 1, Dogon, Amazon Bay Dist., 2400 ft. (730 m), Oct.–Nov. 1962 (W. W. Brandt, C.S.I.R.O.); 1, Mt. Lamington, 1300–1500 ft. (*c.* 400–450 m) (C. T. McNamara, S. Australian Mus.). **N-E. N. G.**: 5, "No. 14," Umi R., Markham Vy., 480 m, dates in Nov. 1959 (Sixth Archbold Exp., A.M.N.H.); 1, Lae, July 1924 (F. E. Skinner, Bishop Mus.); 3, Bulolo, 730, 1170 m, Aug. 15, 19, 21, 1956 (E. J. Ford, Jr., Bishop Mus.); 58, Wau, Morobe Dist., 1200 m, dates in every month except June, 1961–1963 (Sedlacek); 2, same locality, 1700–1800 m, Nov. 17, 1961 (Sedlacek); 4, Sum-Sum, 64 km N. of Wau, 580 m, Feb. 15, 1963 (Sedlacek); 1, Karimui, S. of Goroka, 1000 m, June 3, 1961 (Gressitt), in light trap. **West N. G.**: 3, Hollandia area, W. Sentani, Cyclops Mts., 50–100, 150–250 m, June 17, 22–24, 1959 (Gressitt); 1, Kota Nika, Res. Hollandia, Feb. 14, 1956 (R. T. Simon Thomas, Louwerens Coll.), in light trap.

Measured specimens. The ♂ holotype and 1 ♀ paratype from Finschhafen.

Notes. Although this carabid is apparently common in some places, I failed to find it and do not know its habitat. The localities suggest that it lives in rain forest. Specimens from Bulolo and Hollandia were taken in light traps, which implies that the insect flies.

Genus *COLEOLISSUS* Bates

Bates 1892, Ann. Mus. Civ. Genoa 32, p. 338.
Csiki 1932, Coleop. Cat., Carabidae, Harpalinae 6, p. 1217 (as subgenus of *Trichotichnus*).
Andrewes 1939, Ann. Mag. Nat. Hist. (11) 3, p. 132.

Diagnosis. See *Key to Genera of Harpalini of New Guinea.*

Description (for recognition only). Form of broad medium-sized Harpalini; upper surface (in New Guinean species) very shining, without reticulate microsculpture. *Head*: eyes relatively large (compared with most *Trichotichnus*), almost contiguous with sides of mouth below; frontal impressions deep, subpunctiform or curving toward eyes posteriorly; mentum toothed; ligula rounded, 2-setose; paraglossae attached to ligula but longer, with narrowly rounded apices; penultimate segments labial palpi with more than 2 setae anteriorly. *Prothorax* as in *Trichotichnus*. *Elytra*: sutural angles denticulate (in New Guinean species); striae entire; sutural striae long; 3rd intervals seriate-punctate. *Inner wings* full. *Legs*: tarsi slender. *Secondary sexual characters*: see *Descriptions* of species.

Type species. Hypolithus perlucens Bates, of Kashmir, etc. (fixed by Andrewes, 1939).

Generic distribution. **India** and **Ceylon**, **Sikkim**, **Burma**, etc., to **Java**, **Borneo**, **Philippines** (Negros), **Celebes**, **Buru**, **Moluccas** (Amboina), **New Guinea**, **Solomons**, **New Hebrides**, and the Cape York Pen. of **Australia** (occurrence in Philippines, New Hebrides, and Australia based on unpublished records).

Notes. Members of this genus seem to be rare insects, usually taken only one or two individuals at a time, although they are winged and fly to light. I do not know their habitat.

Key to Species of *Coleolissus* of New Guinea

1. Outer angles of elytra not defined, broadly rounded (p. 65) *papua*

– Outer angles of elytra (before subapical sinuations) well defined, right or obtuse (p. 65) ..... *angulatus*

Coleolissus papua n. sp.

Description. With characters of genus; form as in Figure 26, large, broad; black, appendages irregularly reddish piceous; very shining, elytra iridescent. *Head* 0.73 and 0.72 width prothorax; front faintly punctulate. *Prothorax* transverse; width/length 1.54 and 1.56; base/apex *c.* 1.11 and 1.11; sides broadly rounded to rounded posterior angles; lateral margins broader and more depressed posteriorly; apex margined, base indistinctly so; disc depressed; baso-lateral impressions broad but poorly defined, closely punctate; other parts of disc sparsely or not punctulate. *Elytra* wide; width elytra/prothorax 1.30 and 1.39; base margined; humeri rounded; outer subapical angles rounded; apices slightly sinuate before denticulate sutural angles; striae impunctate; intervals slightly convex, finely sparsely (scarcely detectably) punctulate, 3rd with *c.* 7 small punctures irregularly spaced along most of length of inner edge. *Lower surface*: prosternum and abdomen with a little fine, short, sparse pubescence (scarcely detectable); prosternal process setose. *Secondary sexual characters*: ♂ unknown; ♀ with 2 setae each side last ventral segment. *Measurements*: length 12.5–13.5; width 4.8–5.3 mm.

Types. Holotype ♀ (Bishop Mus.) from Kiunga, Fly R., **Papua** (W. W. Brandt); and 1 ♀ paratype (M.C.Z., Type No. 31,384) from Hollandia area, W. Sentani, Cyclops Mts., **West N. G.,** 150–250 m, June 23, 1959 (T. C. Maa).

Notes. This species is close to *Coleolissus leveri* Van Emden of the Solomons (I have a specimen compared with the type) and even closer to *C. kalisi* Louwerens of Celebes (I have 2 paratypes received by courtesy of Mr. Louwerens). The New Guinean insect is slightly larger and broader than *kalisi*, with broader baso-lateral prothoracic impressions. I collected a single specimen of a *Coleolissus* very similar to *papua* on the Cape York Pen., Australia, in 1958.

Coleolissus angulatus n. sp.

Description. With characters of genus; form as in Figure 27; black, elytra subiridescent, appendages reddish brown. *Head* 0.72 and 0.72 width prothorax; front virtually impunctate. *Prothorax* transverse-subcordate; width/length 1.51 and 1.56; base/apex 1.12 and 1.09; sides converging but usually not sinuate (sometimes slightly so) before ± rounded posterior angles; lateral margins moderately broad and reflexed; apex margined, base not; disc weakly convex, baso-lateral impressions not sharply defined, rather closely but irregularly punctate; disc otherwise less closely but extensively punctate especially across base and at sides, scarcely punctate at middle. *Elytra*: width elytra/prothorax 1.30 and 1.32; basal margin entire, vaguely obtusely angulate at humeri; outer apical angles well defined, usually right, sometimes obtuse; sutural angles denticulate; striae deep, impunctate; intervals slightly irregular but not distinctly punctate, 3rd with *c.* 7 very small punctures irregularly spaced on inner edge along most of length of intervals. *Lower surface*: prosternum not pubescent except for setae at apex of prosternal process; abdomen not pubescent except for usual "fixed" setae. *Secondary sexual characters*: ♂ front tarsi moderately dilated, middle tarsi scarcely so, both pairs 2-seriately squamulose; 2 setae each side last ventral segment in both sexes. *Measurements*: length *c.* 7.5–8.5; width 3.1–3.3 mm.

Types. Holotype ♂ (M.C.Z., Type No. 31,385) and 2 paratypes from Dobodura, **Papua**, Mar.–July 1944 (Darlington); and additional paratypes as follows. **N-E. N. G.**: 3, Finschhafen, 10 and 180 m, Apr. 9–16, 1963 (Sedlacek); 1, Aitape, Aug. 1944 (Darlington). **West N. G.**: 2, Hollandia area, W. Sentani, Cyclops Mts., 150–250 m, June 25, 1959 (Gressitt and T. C. Maa, Bishop Mus.); 1, Ifar, Cyclops Mts., 150–

500 m, Sept. 6–9, 1962 (Sedlacek); 1, "Neth. New Guinea" without further locality, Dec. 10, 1944 (T. Aarons, California Acad.).

Measured specimens. The ♂ holotype and 1 ♀ paratype from Dobodura.

Notes. The deep elytral striation and sharply defined outer elytral angles well characterize this *Coleolissus*. The Dobodura specimens were, I think, taken at light, and some specimens from other localities are evidently from light trap material.

Genus *HYPHAEREON* Macleay

Macleay 1825, Annulosa Javanica, p. 22.
Andrewes 1919, Trans. Ent. Soc. London for 1919, p. 156.
Csiki 1932, Coleop. Cat., Carabidae, Harpalinae 6, p. 1221 (see for additional references).

Diagnosis. Among New Guinean Harpalina this genus is recognizable by: form rather *Nebria*-like; elytra with series of (small) punctures on inner edge 3rd intervals; only 1 seta each side last ventral segment in both sexes.

Description (for recognition only). Form *c. Nebria*-like, convex; reticulate microsculpture faint or absent on head and pronotum, fine and transverse (± visible at 50×) on elytra; elytra subiridescent. *Head*: eyes moderate, narrowly separated from mouth below; mentum toothed; ligula subtruncate, 2-setose; paraglossae rounded, attached to but longer than ligula. *Prothorax* subcordate; anterior marginal line fine but usually entire. *Elytra* with margins sinuate before apex; striae entire; 3rd intervals seriate-punctate. *Inner wings*: see under species. *Secondary sexual characters*: ♂ front and middle tarsi slightly dilated, 2-seriately squamulose; 1 seta each side apex last ventral segment in both sexes.

Type species. H. reflexus Macleay, of Java.

Generic distribution. Known from **Sumatra**, **Java**, **Flores**, **Celebes**, and **New Guinea** (not Australia).

Notes. Of the 3 New Guinean species of *Hyphaereon, timidus* is most like the type species, with which I shall compare it (in *Notes* under *timidus*). *Calathomimus*, which resembles *Hyphaereon* in form and in having only 1 pair of setae on the last ventral segment in both sexes, and which also occurs in the Malay Archipelago (but not New Guinea), is probably closely related to *Hyphaereon* but differs in having strongly angulate humeri.

Key to Species of *Hyphaereon* of New Guinea

1. Humeral margins broadly evenly rounded; elytral striae shallow, intervals flat; setae of apical ventral segment distant from margin by more than 1/10 length of segment (p. 66) ..... *levis*
– Humeral margins obtusely subangulate; elytral striae deeper; setae of last ventral segment less than 1/10 length of segment from margin .. 2
2. Prothorax less cordate, with slightly broader base (width of base/width of head 1.20 and 1.17); wings dimorphic, often much reduced; lowland-living (p. 67) ..... *timidus*
– Prothorax more cordate, with narrower base (width of base of prothorax/width of head 1.14 and 1.12); wings large, folded; mountain-living (p. 68) ..... *cordens*

Hyphaereon levis n. sp.

Description. With characters of genus; form (Fig. 28) average; black, legs testaceous, antennae and mouthparts brown. *Head* 0.67 and 0.66 width prothorax. *Prothorax* subcordate-subquadrate; width length 1.38 and 1.38; base/apex 1.19 and 1.16; base/head 1.10 and 1.07; sides converging and very slightly sinuate before obtuse, blunted posterior angles; baso-lateral impressions poorly defined; disc extensively punctate especially across base and at apex, almost impunctate across middle. *Elytra*: width elytra/prothorax 1.26 and 1.26; details as usual in genus except humeral margins broadly evenly rounded; striae entire but less deep than usual. *Inner wings* full in both specimens. *Measurements*: length *c.* 9.0; width 3.3–3.4 mm.

Types. Holotype ♂ (Leiden Mus.) and 1 ♂ paratype (M.C.Z., Type No. 31,386) both from Sibil, Star Rge., **West N. G.**, 1260 m, June 1959 (Neth. New Guinea Exp.).

Notes. For comparisons, see preceding *Key.*

Hyphaereon timidus n. sp.

Description. With characters of genus; form (Fig. 29) of small, rather broad *Nebria*; black or piceous, appendages testaceous, antennae in part brown. *Head* 0.64 and 0.65 width prothorax. *Prothorax* subcordate-subquadrate; width/length 1.42 and 1.39; base/apex 1.20 and 1.17; base/head 1.20 and 1.17; sides converging and usually slightly, broadly sinuate before obtuse, slightly blunted posterior angles; anterior marginal line entire or not (variation individual); baso-lateral impressions poorly defined; disc finely irregularly punctate basally, *c.* impunctate elsewhere. *Elytra*: width elytra/prothorax 1.19 and 1.23; humeri obtusely but usually distinctly angulate; striae deep, intervals convex. *Wings* dimorphic or polymorphic (see *Notes*, below). *Secondary sexual characters* as for genus. *Measurements*: length *c.* 6–7; width 2.6–2.9 mm.

Types. Holotype ♂ (M.C.Z., Type No. 31,387) and 55 paratypes from Dobodura, **Papua**, Mar.–July 1944 (Darlington); 20 paratypes from Oro Bay (near Dobodura), Dec. 1943–Jan. 1944 (Darlington).

Additional material. **N-E. N. G.**: 17, Nadzab, July 1944 (Darlington); 1, same locality, June 1944 (Krombein, U.S.N.M.); 1, Erima, Astrolabe Bay, 1896 (Biró); 1, Busu R., "12 km," Sept. 21, 1956 (E. J. Ford, Jr., Bishop Mus.). **West N. G.**: 34, Hollandia, July–Sept. 1944 (Darlington); 6, same locality, May 1945 (B. Malkin, U.S.N.M.); 5, Sabron, Cyclops Mts., 930 ft. (*c.* 280 m), Apr. 1936 (Cheesman).

Measured specimens. The ♂ holotype and 1 ♀ paratype from Dobodura.

Notes. This new species is similar to *Hyphaereon reflexus* Macleay (the type species of the genus) of Java, but *timidus* differs slightly in proportions (e.g., the base of the prothorax is relatively narrower than in *reflexus*) and the pronotum of *timidus* is less extensively punctate.

The wings of this species vary (Figs. 29, A, B), and the variation is complex, being partly individual, partly geographic, and partly correlated with body size. Of the specimens from Dobodura, 5 have wings large and folded at apex; 51, strongly reduced. However, both the long- and the short-winged forms are variable in the Dobodura series. Among the long-winged individuals, some have wings about 10% shorter than others and with slightly weakened venation, and among the short-winged ones, the wing vestiges vary from about ¾ to about ½ the length of an elytron. In the series from Oro Bay (only a few miles from Dobodura) the proportion of long- and short-winged individuals is different: 10 are long-winged, 9 short-winged. Seventeen specimens from Nadzab and 3 from other localities in N-E. N. G. are all fully winged or at least have wings long and folded at apex. But my series from Hollandia is again dimorphic: 7 specimens are long-winged, 27 short-winged. All the long-winged specimens from Dobodura, Oro Bay, and Hollandia are large. Some short-winged individuals are equally large, but there is much more variation in size among the short-winged ones. I do not remember noting this correlation in any other Carabidae. I have not studied state of wings in specimens not collected by myself because I do not know how they were taken, and method of collecting may have favored getting one wing class more than another.

It is doubtful if even the long-winged form of this species flies. Individuals are common at some localities where much collecting has been done, but few have been obtained except by myself (on the ground), and no specimen is labeled as taken at light. The variation and use of wings in this species would be an interesting subject for study in the field.

Although my field notes are scanty, I think my series of this species were taken among dead leaves and vegetation on the ground near water.

Hyphaereon cordens n. sp.

Description. With characters of genus; form *Nebria*-like; black or piceous, appendages irregularly brown, darker than in other species. *Head* 0.67 and 0.67 width prothorax. *Prothorax* cordate; width/length 1.35 and 1.43; base/apex 1.23 and 1.18; base/head 1.14 and 1.12; sides converging and broadly sinuate before slightly obtuse (almost right), slightly blunted posterior angles. *Elytra c.* 3/10 or more wider than prothorax (elytra/prothorax 1.32 and 1.32); humeri ± subangulate; striae deep, intervals convex. *Wings* fully developed, or at least long and folded at apex, in all specimens. *Secondary sexual characters* as for genus. *Measurements*: length *c.* 7–8.5; width 2.7–3.4 mm.

Types. Holotype ♂ (M.C.Z., Type No. 31,388) and 77 paratypes all from Chimbu Vy., Bismarck Rge., **N-E. N. G.,** 5000–7500 ft. (*c.* 1500–2300 m), Oct. 1944 (Darlington).

Additional material. **N-E. N. G.**: 1, Kainantu, 1650 m, Oct. 20–26, 1959 (T. C. Maa, Bishop Mus.); 1, Wau, Morobe Dist., 1200 m, Dec. 4–5, 1961 (Sedlacek), in mercury vapor light trap.

Measured specimens. The ♂ holotype and 1 ♀ paratype.

Notes. Although this species is evidently sometimes common, and although all specimens are fully winged, they are rarely taken in light traps, which suggests that even this winged species rarely flies. Whether it is a real species or a local form of *timidus* is not possible to say from museum specimens. In any case it is clearly distinguishable as indicated in the preceding *Key*.

Genus *ANOPLOGENIUS* Chaudoir

Chaudoir 1852, Bull. Soc. Nat. Moscow 25, 1, p. 88.
Csiki 1932, Coleop. Cat., Carabidae, Harpalinae 6, p. 1236.
Schauberger 1937, Ent. Rundschau 54, p. 272.
Basilewsky 1951, Ann. Mus. Congo Belge (8), Zool., 9, p. 122 (see for synonymy and additional references).

Diagnosis. Relatively large Acupalpina; anterior marginal line of pronotum entire and deeply impressed; scutellar striae absent.

Description. None required here.

Type species. Stenolophus alacer Dejean, of Africa.

Generic distribution. The warmer parts of the **Old World**; in the **Oriental-Australian area**, from **China** and **Japan** to northern **Australia**.

Notes. The species of this genus are among the most aquatic of Carabidae, occurring as a rule in vegetation that is floating in water. They are active and winged and are common in some places, including the Philippines, although unaccountably rare or local in New Guinea.

Anoplogenius marginatus (Macleay)

Macleay 1888, Proc. Linnean Soc. New South Wales (2) 3, p. 472 (*Harplaner*).
?*incisus* Andrewes 1926, Ann. Mag. Nat. Hist. (9) 18, p. 279.
?*politus* Schauberger 1937, Ent. Rundschau 54, p. 273.

Description. None needed here. See *Notes* below; length *c.* 6.5–8.0 mm.

Types. Of *marginatus*, from King's Sound, **Australia**; probably in Macleay Mus., Sydney (not seen). Of *incisus*, from Fort de Kock, **Sumatra**; in British Mus. (seen). Of *politus*, from "Tigerinsel (New Guinea)" (? = Matjan, Pulau-Pulau, which is really not off New Guinea but south of **Celebes**); in Stockholm Mus. (not seen).

Occurrence in New Guinea. The only (supposedly) New Guinean specimens of *Anoplogenius* known to me are: 1 labeled simply "**Papua**," presumably collected by Biró, now in Hungarian National Mus.; several from "Dorey, New Guinea," presumably collected by Wallace and perhaps actually from Celebes (see Part I of the present work, pp. 330–331); and the types of *politus* from "Tigerinsel," probably off Celebes rather than New Guinea.

Notes. The Oriental-Australian species of *Anoplogenius* are taxonomically difficult at best, and in the case of this New Guinean

species the difficulty is increased by lack of adequate material and by doubt about localities, as indicated above. The three authors concerned published their descriptions without reference to each other, but Andrewes and Schauberger both compared their species with *A. cyanescens* Hope, and Macleay's *Harplaner marginatus* is apparently an *Anoplogenius* near *cyanescens* (B. P. Moore, personal communication, 1965). I therefore tentatively conclude that *incisus*, *politus*, and *marginatus* are probably all one species which ranges at least from **Sumatra** to **New Guinea** and northern **Australia**. This species is narrowly or indistinctly pale-margined, with relatively distinct (narrowly rounded) posterior prothoracic angles, and with baso-lateral impressions of pronotum extensively punctate. I have specimens with these characters from Morotai Island in the **Moluccas**, and from Townsville and Rockhampton, **Australia**.

Genus *EGADROMA* Motschulsky

Motschulsky 1855, Étude Ent. 4, p. 43.
Csiki 1932, Coleop. Cat., Carabidae, Harpalinae 6, p. 1239 (as subgenus of *Acupalpus*) (see for additional references).
Jeannel 1942, Faune de France, Coléop. Carabiques, Part 2, p. 699.
Basilewsky 1951, Ann. Mus. Congo Belge (8), Zool., 9, p. 144.

Diagnosis. See *Key to Genera of Harpalini of New Guinea.*

Description. None required here.

Type species. Carabus smaragdulus Fabricius, below.

Generic distribution. The warmer parts of the **Old World**: **Africa** and **Madagascar** (1 species reaching the Mediterranean part of **Europe**); southern **Asia** north to **Japan**, and across the **Malay Archipelago** to the **Philippines** and **Australia**.

Notes. The Oriental-Australian species of *Egadroma* are exceptionally difficult. They are closely related or at least very similar among themselves; they vary geographically and individually; and some species are widely distributed and very common, so that many specimens fell into the hands of early taxonomists who described them inadequately and failed to understand their interrelationships. I do not pretend fully to understand them now, but can make the following comments on the species that occur in New Guinea. Three common species occur there, distinguishable by both external and genitallic characters. (A fourth, endemic species is known from a single ♀.) All three are widely distributed outside New Guinea and at least two of them have received different names in different places. To fix the synonymy of these species outside New Guinea would be a major, time-consuming undertaking, and is beyond my power now. I shall therefore simply use for each species the name that I think applies in New Guinea, with tentative notes on synonymies.

Although I did not always distinguish the species in the field, my notes suggest that *quinquepustulata* and *smaragdula* occur in wet places usually by standing water, but that *robusta* occurs principally in drier habitats, especially under cover in open grassland. All these species are winged, and all fly to light.

KEY TO SPECIES OF *EGADROMA* OF NEW GUINEA

1. Size larger (*c.* 6–7 mm); elytra conspicuously 3- or 5-maculate, and very shining; apex of aedeagus long (p. 70) ..... *quinquepustulata*
– Usually smaller (less than 6 mm, except in *cyclops*); usually with reduced or no markings, and often (not always) less shining; apex of aedeagus shorter (except unknown in *cyclops*) 2
2. Large (7.4 mm) (p. 70) ..... *cyclops*
– Smaller (less than 6 mm) 3
3. Form relatively narrower, with relatively wider head (head usually more than 0.74 width prothorax, prothoracic width/length usually less than 1.45); elytra rather strongly iridescent; aedeagus finely notched at sides (p. 70) ..... *smaragdula*
– Broader, with relatively narrower head (head usually less than 0.74 width prothorax, prothoracic width/length usually more than 1.45); elytra less iridescent, usually with distinct microreticulation; aedeagus not notched at sides (p. 71) ..... *robusta*

Egadroma quinquepustulata (Wiedemann)

5pustulatus Wiedemann 1823, Zoologisches Magazin (2) 1, p. 58 (*Badister*).
Csiki 1932, Coleop. Cat., Carabidae, Harpalinae 6, p. 1240 (see for additional references).
Habu 1961, *in* Kira and Umesao, Nature and Life in Southeast Asia (Kyoto) 1, p. 276, fig. 4 (♂ genitalia).

Description. None needed here; see preceding *Key to Species* and following *Notes*; length *c.* 6–7 mm.

Type(s). From Bengal, **India**; in Copenhagen U. Mus. (not seen).

Occurrence in New Guinea. Widely distributed at low altitudes, fairly common: 41 specimens from localities over most of the length of **New Guinea** (Papua to the Vogelkop); most at low altitudes, but 1, Chimbu Vy., Bismarck Rge., 5000–7500 ft. (*c.* 1500–2300 m), and 1, Wau, 1200 m.

Notes. This relatively large, clearly marked, and therefore comparatively easily recognized *Egadroma* ranges from SE. **Asia** including **Japan** and **Formosa** across the **Malay Archipelago** to North Queensland, **Australia**. In the past, the species has often been treated as a variety of *smaragdula* but it is unquestionably distinct by genitallic as well as external characters.

Specimens from New Guinea vary in elytral markings, the variation being individual, not geographic. Conspicuous posthumeral pale spots are always present, and a variable (sometimes faint) subapical sutural mark is always present too, but anteapical spots on the 7th and 8th intervals are variably developed and often absent.

Egadroma cyclops n. sp.

Description. Form as in Figure 30, large, broad; side margins of prothorax testaceous-translucent, of elytra scarcely so; appendages reddish testaceous, antennae darker from 3rd segment; shining, front with isodiametric reticulate microsculpture, discs of pronotum and elytra not visibly microreticulate (at 50×) but moderately iridescent. *Head* 0.68 width prothorax; formed as usual in genus. *Prothorax* transverse; width/length 1.45; base/apex 1.22; sides rounded, with moderate reflexed margins; basal angles rounded; base not margined, apical marginal line interrupted at middle; baso-lateral impressions broad, shallow, *c.* rugose-punctate, with punctation finer and sparser at middle of base. *Elytra*: width elytra/prothorax 1.33; humeri prominent but rounded; striae deep, impunctate; scutellar striae long; intervals finely sparsely punctulate, 3rd with 1 puncture on inner edge less than ¼ from apex. *Wings* full. *Lower surface*: prosternum with some short pubescence; abdomen not pubescent at apex. *Secondary sexual characters*: ♂ unknown, ♀ normal. *Measurements*: length 7.4; width 3.3 mm.

Type. Holotype ♀ (Bishop Mus.) from Hollandia area, W. Sentani, Cyclops Mts., **West N. G.,** 50–100 m (Gressitt and T. C. Maa), in light trap.

Notes. This new species resembles *smaragdula* but is larger (a large *smaragdula* is less than 6 mm long), with relatively narrower head. I feel sure it is a distinct species although represented by only a single ♀ specimen.

Egadroma smaragdula (Fabricius)

Fabricius 1798, Supplementum Ent. Systematicae, p. 60 (*Carabus*).
Csiki 1932, Coleop. Cat., Carabidae, Harpalinae 6, p. 1241 (see for additional references).
Jedlicka 1935, Acta Soc. Ent. Czechoslovakia 32, p. 113 (in key).
Habu 1961, *in* Kira and Umesao, Nature and Life in Southeast Asia (Kyoto) 1, p. 275, fig. 3 (♂ genitalia).

Description. None required here; see preceding *Key to Species*; length ± 5 mm.

Type(s). From "**India orientali**"; in Copenhagen Univ. Mus. (not seen).

Occurrence in New Guinea. Common at low altitudes probably throughout **New Guinea**: 121 specimens from Milne Bay and Port Moresby to the Vogelkop; most at low altitudes but 2 from Wau and 1 from Rattan Camp at 1200 m.

Notes. This is the common, unmarked (at most with a faint rufescent area along

suture posteriorly) *Egadroma* of the Oriental-Australian area. It apparently extends from **Asia** to northern **Australia** but, because of difficulty in distinguishing it from similar forms, I have not tried to fix the exact limits of its range.

Egadroma robusta Sloane

Sloane 1907, Deutsche Ent. Zeitschrift for 1907, p. 469.
Andrewes 1927, Ann. Mag. Nat. Hist. (9) 19, p. 110 (as synonym of *dingo* Castelnau).
Csiki 1932, Coleop. Cat., Carabidae, Harpalinae 6, p. 1242 (as synonym of *vestigialis*).

Description. None required here. See preceding *Key to Species* and *Notes*, below; length ± 5 mm.

Types. From Gazelle Pen., **New Britain**; should now be in Deutsches Ent. Mus., Berlin-Dahlem (not seen).

Occurrence in New Guinea. Very common throughout **New Guinea** at low altitudes: 368 specimens from many localities from Milne Bay and Normanby, Ferguson, Rossel, and Sudest Islands, Papua, to western part of West N. G. Although this species does not commonly occur at altitudes of more than a few hundred meters, I have seen 4 from Wau, 1200 m, and 1, Chimbu Vy., 5000–7500 ft. (*c.* 1500–2300 m). Specimens have been collected in every month.

Notes. Most individuals of this species from New Guinea have the elytra unmarked or with only small posthumeral pale marks on the 6th intervals, rarely extending to the 5th and 7th intervals. Similar unmarked individuals occur in **New Britain** (types of *robusta*) and Cape York, **Australia** (collected by me in 1958). However, a few specimens from New Guinea, mostly from the far west including Biak Island, have also pale subapical sutural dashes and variable subapical pale spots, best developed on the 7th intervals. These specimens *may* be referable to *Egadroma quadrimaculata* (Macleay), which was described from Australia, but which *may* extend across the Malay Archipelago at least to Java. In other words, *robusta* may be an unspotted form (occurring principally but not exclusively on New Guinea) of a more widely distributed maculate species, tentatively identified as *quadrimaculata* Macleay. This case requires further study.

Most individuals of *robusta* are easily separable from *smaragdula* by proportions (indicated in the preceding *Key*) and duller surface. Apparent intermediates do, rarely, occur. I do not know whether they are hybrids or individual variants. These two species probably occupy different habitats: *smaragdula*, wet places; *robusta*, relatively dry ones.

Genus *STENOLOPHUS* Stephens

Stephens 1828, Illustrations British Ent., Mandibulata 1, pp. 67, 165.
Csiki 1932, Coleop. Cat., Carabidae, Harpalinae 6, p. 1259 (see for synonymy and additional references)
Jeannel 1942, Faune de France, Coléop. Carabiques, Part 2, p. 693.
Basilewsky 1951, Ann. Mus. Congo Belge (8), Zool., 9, pp. 118, 213 (in text).

Diagnosis. See *Key to Genera of Harpalini of New Guinea.*

Description. None required here.

Type species. Carabus teutonus Schrank, of Europe, etc. (see Jeannel, 1942).

Generic distribution. **Eurasia** and **North America**, and probably the **Oriental Region** and **Malay Archipelago** to **Australia**; (probably not Africa below the Sahara, although closely related genera occur there). See *Notes*, below.

Notes. Jeannel and Basilewsky have divided *Stenolophus*, and Basilewsky suggests that the genus in a strict sense may be confined to the Holarctic Regions. However, the following two New Guinean species seem to fit reasonably well in *Stenolophus* according to characters given by Basilewsky (1951, p. 213). Moreover, one of these two species (*gonidius*) has the first segment of the posterior tarsi plainly carinate while the other (*volucer*) has not, which suggests that this character, which has been used in dividing *Stenolo-*

phus, is less important than has been thought. I shall therefore leave both New Guinean species in *Stenolophus*, where in fact earlier authors put them.

Both the following two species are apparently widely distributed in the Malay Archipelago, and I have specimens probably representing both from North Queensland, Australia, but because of doubt about identifications I prefer not to state their distributions in detail.

KEY TO SPECIES OF *STENOLOPHUS* OF NEW GUINEA

1. Sides of prothorax sinuate before base, with basal angles nearly right and scarcely blunted (p. 72) ... *volucer*
– Sides of prothorax *c.* straight, converging but not or scarcely sinuate posteriorly, with basal angles obtuse, narrowly rounded (p. 72) ... *gonidius*

Stenolophus volucer Andrewes

Andrewes 1930, Arkiv för Zoologi 21A, No. 29, p. 5.

Description. None required here; length *c.* 5.5–6.0 mm.

Types. Five, from **Sumatra**; actual "type" in Stockholm Mus. (not seen).

Occurrence in New Guinea. **Papua**: 52 specimens from various localities, including a series from Dobodura. **N-E. N. G.**: 1, Nadzab, July 1944 (Darlington). **West N. G.**: 1, River Tor (mouth) 4 km E. Hol Maffen, July 19, 1959 (T. C. Maa, Bishop Mus.).

Notes. See *Notes* under the genus. I have identified this species from description, and am not quite sure of it. It is, as Andrewes says, about the size and color of *gonidius* (below) but with lateral borders of elytra darker and with differently formed prothorax.

Stenolophus gonidius Bates

Bates 1890, Ann. Mus. Civ. Genoa 27, p. 104.
Csiki 1932, Coleop. Cat., Carabidae, Harpalinae 6, p. 1262 (see for additional references).
Andrewes 1933, Cat. Carabidae Sumatra, p. 317.

Description. None required here; length *c.* 5.5–6.5 mm.

Types. From **Burma**; in Genoa Mus. (not seen).

Occurrence in New Guinea. **Papua**: 31 specimens from Dobodura, Oro Bay, Port Moresby, Fly R., and Ferguson Is. **N-E. N. G.**: 1, Finschhafen, Huon Pen., 80 m, Apr. 16, 1963 (Sedlacek), in Malaise trap. (No specimens from West N.G.)

Notes. See *Notes* under the genus. Although I have seen a cotype of *gonidius* in the British Museum and have made comparisons with it, I am not quite sure of the identity of the New Guinean specimens.

Genus *ACUPALPUS* Latreille

Latreille 1829, *in* Cuvier, Règne Animal, ed. 2, 4, p. 391.
Csiki 1932, Coleop. Cat., Carabidae, Harpalinae 6, pp. 1238, 1242.
Jeannel 1942, Faune de France, Coléop. Carabiques, Part 2, p. 712.
Basilewsky 1951, Ann. Mus. Congo Belge (8), Zool., 9, pp. 232, 233.

Diagnosis. See preceding *Key to Genera of Harpalini of New Guinea* and following *Notes*. I have tentatively assigned to this genus all the small Harpalini of New Guinea (6 species) that possess *long*, sparse prosternal setae. All are winged. The front tarsi of the ♂ are not or at most (in *furvinus*) slightly dilated, with squamae thin, transparent, difficult to detect, and perhaps absent in some cases.

Description. None required here.

Type species. Carabus meridianus Linnaeus, of Europe.

Generic distribution. Now considered to include all principal regions of the **world**, but the generic classification of these small Harpalini is not fully worked out. At least 3 stocks of this genus reach northern tropical Australia, but they apparently do not extend far into southern temperate Australia, where their place is taken by small species of *Lecanomerus* (see discussion under Tribe Harpalini).

Notes. Several species of this genus either range widely in the Oriental-Australian area or belong to wide-ranging groups of closely interrelated species. Their nomenclature is

difficult, and synonymies outside New Guinea remain to be determined.

Key to Species of *Acupalpus* of New Guinea

1. Anterior margin of clypeus not notched or impressed at sides (at most slightly sinuate); base of prothorax *c.* squarely truncate, with posterior angles *c.* rectangular 2
– Anterior margin of clypeus notched or impressed at sides; posterior angles of prothorax usually more obtuse or rounded 3
2. Larger (*c.* 3.7 mm); elytral margins behind humeri faintly serrate at 50× (p. 73) .. *exactus*
– Smaller (*c.* 2.7 mm); elytral margins not visibly serrate at 50× (p. 73) .... *exactellus*
3. Prothorax with baso-lateral impressions not punctate; posterior angles (narrowly) rounded (p. 74) ..... *furvinus*
– Prothorax with baso-lateral impressions punctate; posterior angles usually more distinct .. 4
4. Color brown with darker head; prothorax with base more oblique at sides and posterior angles more obtuse (p. 74) ..... *brunnicolor*
– Color darker, more uniform; prothorax with base less oblique at sides and basal angles more nearly right 5
5. Smaller (3.0–3.3 mm) (p. 75) ..... *ustus*
– Larger (3.5–4.2 mm) (p. 75) ..... *papua*

Acupalpus exactus n. sp.

Description. With characters of genus; form (Fig. 31) relatively slender, elytra subparallel; piceous, clypeus etc. reddish, margins of prothorax rather broadly and indefinitely reddish, suture and margins of elytra narrowly but conspicuously reddish, appendages testaceous; shining, dorsal microsculpture faint or absent. *Head* 0.84 and 0.85 width prothorax; eyes large, prominent; frontal impressions deep, converging anteriorly, ending at deep clypeal suture; anterior margin of clypeus slightly sinuate but not distinctly notched at sides; mandibles long; mentum not toothed; ligula slender, free at apex, 2-setose; paraglossae slightly longer than ligula, narrowly rounded; palpi with apical segments subconical. *Prothorax* broadly subcordate; width/length 1.34 and 1.30; base/apex 1.10 and 1.07; sides broadly rounded anteriorly, slightly converging and broadly sinuate to *c.* right, sharply defined posterior angles; base and apex not margined; lateral margins moderate, not crenulate; baso-lateral impressions large, deep, irregular but not distinctly punctate; disc normal, impressed median line groove-like at base. *Elytra* long; width elytra/prothorax 1.47 and 1.52; humeri prominent but rounded; margins behind humeri visibly serrate (at 50×); striae deep, entire; intervals convex, 3rd with puncture on inner edge well behind middle. *Measurements*: length *c.* 3.7; width 1.4–1.5 mm.

Types. Holotype ♀ (M.C.Z., Type No. 31,389) from Hollandia, **West N. G.,** July–Sept. 1944 (Darlington); and 1 ♀ paratype (Bishop Mus.) from Kiunga, Fly R., **Papua**, July 15–21, 1957 (W. W. Brandt); 1 paratype, Popondetta, **Papua**, 25 m, May 1966 (Shanahan-Lippert, Bishop Mus.), light trap.

Notes. This New Guinean species resembles and is probably related to *Acupalpus horni* Andrewes of SE. Asia but is darker, with lateral margins of prothorax not crenulate (faintly crenulate in *horni*), and with baso-lateral impressions of pronotum less linear. Other apparently related forms occur in the Philippines, Moluccas (Morotai Is.), and North Queensland in Australia.

Acupalpus exactellus n. sp.

Description. With characters of genus; smaller and relatively shorter than *exactus* (above); piceous, margins of prothorax and elytra not or not conspicuously paler, appendages testaceous; moderately shining, reticulate microsculpture (slightly transverse) visible on front anteriorly but absent on discs of prothorax and elytra. *Head* 0.75 and 0.76 width prothorax; eyes relatively much smaller than in *exactus*, with genae more oblique; front similarly impressed; clypeus without distinct notches at sides anteriorly; mouthparts as in *exactus*. *Prothorax* broadly subcordate with wide base; width/length 1.40 and 1.42; base/apex 1.24 and 1.16; sides broadly arcuate, slightly converging and broadly sinuate to *c.* rectangular posterior angles; base and apex not margined; lateral margins narrow an-

teriorly, broader posteriorly, not crenulate; baso-lateral impressions broad, deep, irregular, but not distinctly punctate; disc normal, with middle line deeply impressed basally. *Elytra*: width elytra/prothorax 1.41 and 1.45; humeri broad but rounded; margin behind humeri not visibly serrate (at 50×); striae and dorsal punctures as in *exactus*. *Secondary sexual characters*: ♂ front tarsi not dilated and apparently without squamae (see *Notes*, below). *Measurements*: length *c.* 2.7; width 1.3 mm.

Types. Holotype ♂ (M.C.Z., Type No. 31,390) and 1 ♀ paratype from Hollandia, **West N. G.,** July–Sept. 1944 (Darlington).

Notes. So far as I know, the only species with which the present one need be compared is *exactus* (above), with which comparison is made in the *Key* and preceding *Description*.

Although the type is a ♂ (dissected), the anterior tarsi are slender and without the expected squamae, so far as I can determine under highest power of my stereoscopic microscope.

Acupalpus furvinus n. sp.

Description. With characters of genus; form rather elongate; reddish piceous, sides of prothorax and suture and sides of elytra more reddish, appendages irregularly testaceous, antennae brownish except at base; shining, but front with light isodiametric microsculpture, pronotum with more transverse microreticulations at most faintly indicated, elytra with distinct transverse meshes (at 50×) but slightly iridescent. *Head* 0.71 and 0.73 width prothorax; eyes moderate; front impressed as usual; clypeus with anterior margin notched or impressed at sides; mouthparts as in *exactus*. *Prothorax* subquadrate; width length 1.31 and 1.31; base/apex 1.10 and 1.11; sides broadly rounded anteriorly, nearly straight (or slightly rounded) and converging posteriorly to narrowly rounded posterior angles; base and apex not margined; margins moderate, broader posteriorly and running into irregular, rounded, not distinctly punctate baso-lateral impressions; disc as usual. *Elytra*: width elytra/prothorax 1.38 and 1.39; striae entire, well impressed; 3rd intervals 1-punctate on inner edge behind middle. *Secondary sexual characters*: ♂ front tarsi slightly dilated, 4th segments deeply emarginate, 4 segments 2-seriately squamulose. *Measurements*: length 3.5–4.7; width 1.5–1.8 mm.

Types. Holotype ♂ (M.C.Z., Type No. 31,391) and 6 paratypes from Dobodura, **Papua**, Mar.–July 1944 (Darlington); and additional paratypes as follows. **Papua**: 1, Lake Daviumbu, Fly R., Sept. 21–30, 1936 (Archbold Exp., A.M.N.H.). **N-E. N. G.**: 1, Aitape, Aug. 1944 (Darlington).

Measured specimens. The ♂ holotype and 1 ♀ paratype from Dobodura.

Notes. According to my notes made at the British Museum in 1948, this species represents a widely distributed Oriental-Australian group of *Acupalpus* which includes *annamensis* Bates and *furvus* Andrewes of SE. Asia, as well as various named forms from the Malay Archipelago. Most of them are testaceous with dark elytral clouds, but *furvus* is more uniformly colored, as is *furvinus*. However, the latter differs from *furvus* in having more prominent eyes and less rounded posterior prothoracic angles. A representative of this species group occurs in North Queensland, Australia.

Acupalpus brunnicolor (Sloane)

Sloane 1898, Proc. Linnean Soc. New South Wales 23, p. 466 (*Thenarotes*).

Andrewes 1930, Cat. Indian Insects, Part 18, Carabidae, p. 10.

Description (for recognition only). A brown *Acupalpus* characterized in preceding *Key to Species*; head 0.82 and 0.82 width prothorax; prothoracic width/length 1.44 and 1.42, base/apex 1.13 and 1.16; width elytra/prothorax *c.* 1.43 and 1.38; length *c.* 3.8, width 1.5–1.6 mm.

Types. From Behn River, **Western Australia**, collected by Helms; type returned to Lea, should be in South Australian Mus. (not seen).

Occurrence in New Guinea. **Papua**: 3, Port Moresby, Oct. 1944 (Darlington); 1, Oriomo River, Feb. 17, 1967 ("H. C.," Bishop Mus.), light trap.

Measured specimens. A pair (♂ ♀) from Port Moresby.

Notes. According to notes that I made at the British Museum in 1947–1948, *brunnicolor* of Australia may be a form of a widely distributed species that has received the name *sinuellus* Bates in SE. Asia and *punctatus* Jedlicka in the Philippines. However, the classification of these small harpalines is still so doubtful that I do not wish to declare synonymies, but shall say only that *brunnicolor* probably represents a widely distributed species group that may have reached Australia recently (perhaps by way of the Lesser Sunda Islands) and that may then have spread from Australia to the *Eucalyptus* country of southern New Guinea.

Acupalpus ustus Andrewes

Andrewes 1930, Zool. Mededelingen 13, p. 195.

Description (for recognition only). With characters of genus; form rather stout; piceous, moderately shining. *Head* 0.76 and 0.77 width prothorax; eyes average. *Prothorax* subcordate; width/length 1.38 and 1.37; base/apex 1.12 and 1.10; sides variably sinuate before obtuse (almost right) posterior angles; disc normal, baso-lateral impressions punctate, punctation absent or sparse across middle of base. *Elytra*: width elytra/prothorax 1.43 and 1.44. *Measurements* (in New Guinea): length 3.0–3.3; width 1.3–1.4 mm.

Types. From **Sumatra** and **Borneo**; the (holo)type, from Borneo, in Andrewes Coll., British Mus. (seen).

Occurrence in New Guinea. **Papua**: 29, Dobodura, Mar.–July 1944 (Darlington). **West N. G.**: 1, Hollandia, July–Sept. 1944 (Darlington).

Measured specimens. A pair (♂ ♀) from Dobodura.

Notes. My identification is tentative, although based on comparison of specimens with the type. As in other species of this genus, I am not absolutely sure of synonymies and make none, but only state that this species appears to be widely distributed in the Malay Archipelago.

Acupalpus papua n. sp.

Description. With characters of genus; form (Fig. 32) rather broad, with sides of elytra slightly arcuate; piceous, apices of elytra sometimes rufescent, appendages testaceous, antennae browner from 3rd segments; moderately shining, reticulate microsculpture distinct and *c.* isodiametric on front, faint (and more transverse) or absent on disc of pronotum, not visible (at 50×) on slightly iridescent elytra. *Head* 0.82 and 0.80 width prothorax; eyes moderate; frontal impressions extending onto clypeus; anterior edge of clypeus finely notched at sides; mouthparts *c.* as in *exactus*. *Prothorax* broadly subcordate; width/length 1.43 and 1.46; base/apex 1.15 and 1.10; sides broadly rounded anteriorly, converging and slightly, broadly sinuate before slightly obtuse but well defined posterior angles; margins moderate anteriorly, broader posteriorly, with baso-lateral areas depressed and punctate, punctation not extending across middle of base. *Elytra*: width elytra/prothorax 1.46 and 1.48; humeri broadly rounded; margins behind humeri not distinctly serrate at 50×; striae moderately impressed; 3rd intervals 1-punctate on inner edge as usual. *Measurements*: length 3.5–4.2; width 1.5–1.8 mm.

Types. Holotype ♂ (M.C.Z., Type No. 31,392) and 4 paratypes from Dobodura, **Papua**, Mar.–July 1944 (Darlington); and additional paratypes as follows. **Papua**: 1, Oro Bay (near Dobodura), Dec. 1943–Jan. 1944 (Darlington); 1, Fly R., Lake Daviumbu, Sept. 1–10, 1936 (Archbold Exp., A.M.N.H.). **West N. G.**: 2, Hollandia, July–Sept. 1944 (Darlington).

Measured specimens. The ♂ holotype and 1 ♀ paratype from Dobodura.

Notes. Except that it is close to *ustus* (above), I cannot state the relationships of this new species. As compared with *ustus*, *papua* is larger, with relatively slightly wider head and wider prothorax.

Tribe ANAULACINI

Csiki 1932, Coleop. Cat. Carabidae, Harpalinae 7, p. 1287 (see for synonymy and additional references).
Jedlicka 1963, Ent. Abhandlungen 28, p. 283.
Masoreini Auct.
Andrewes 1930, Cat. Indian Carabidae, p. XIII.
Jeannel 1949, Coléop. Carabiques de la Région Malgache, Part 3, p. 860.
Masoreitae Jeannel 1942, Faune de France, Coléop. Carabiques, Part 2, p. 1012.
Masoreinae Basilewsky 1953, Exploration Parc National l'Upemba, Fasc. 10, Carabidae, pp. 17, 118.

This is a small, pan-tropical tribe of obscure Carabidae some of which, including all those found in New Guinea, superficially resemble Nitidulidae. They may be recognized by appearance (Figs. 33, 34); short, strongly arcuate, flattened mandibles; rather long tibial spurs; and other technical characters given by authors cited above. All the species that I know are winged, and the widely distributed *Aephnidius adelioides* flies to light, but *Odontomasoreus* has not been taken at light and perhaps does not fly. The few species that I have collected in New Guinea and Australia live in leaf litter on the ground in rain forest. Four genera of the tribe are known from New Guinea.

Key to Genera of Anaulacini of New Guinea

1. Humeri dentate; (antennae short, not reaching base of prothorax; labrum rounded; mentum lobed or subdentate; elytra pale-spotted) (p. 76) *Odontomasoreus*
– Humeri not dentate 2
2. Antennae short, not reaching base of prothorax (p. 77) *Anaulacus*
– Antennae longer, reaching or passing base of prothorax 3
3. Mentum not toothed; size larger, *c.* 5 mm (p. 77) *Aephnidius*
– Mentum toothed; smaller, less than 3 mm (p. 78) *Caphora*

ODONTOMASOREUS n. gen.

Diagnosis. Rather small, convex Anaulacini; immediately distinguished from other genera of tribe by humeri dentate.

Description. Form nitiduloid (Fig. 33), convex; color piceous with pale elytral marks; reticulate microsculpture isodiametric on head, slightly and irregularly transverse on pronotum and elytra. *Head* normal, *c.* as in *Aephnidius adelioides* except labrum rounded; antennae short, reaching *c.* middle of prothorax, with median segments wider than long; mentum bluntly toothed or obtusely prominent at middle. *Prothorax* normal; anterior angles moderately advanced; base sinuate but scarcely lobed; disc with fine, abbreviated middle line. *Elytra*: humeri finely dentate; margins weakly sinuate near apex; striae indicated but scarcely impressed, scutellar striae not visible. *Secondary sexual characters*: ♂ tarsi slightly dilated, 3 segments 2-seriately squamulose; ♂ copulatory organs as in Figure 175.

Type species. Odontomasoreus humeralis (below).

Generic distribution. Known only from **New Guinea**, thus far only from the eastern and central parts of the island.

Notes. I recognize only 1 species of this new genus, with 2 subspecies.

Key to Subspecies of *Odontomasoreus humeralis*

1. Larger (3.4–4.0 mm); humeri broadly pale (Papua) (p. 76) *humeralis s.s.*
– Smaller (3.1–3.5 mm); humeri dark or at most with vague or small pale areas (N-E. N. G. and eastern West N. G.) (p. 77) subsp. *reductus*

Odontomasoreus humeralis n. sp.

Description. With characters of genus; form as in Figure 33; brownish piceous, humeri, base of elytra, and an elongate mark on 2nd interval of each elytron near apex testaceous; mouth parts and appendages brownish or testaceous. *Head* 0.60 and 0.63 width prothorax. *Prothorax* widest near base, narrowed anteriorly; width/

length 1.81 and 1.81; base/apex 1.42 and 1.39; sides weakly arcuate, very narrowly margined, each with usual 2 setae, at base and *c.* ⅔ from apex; base finely margined, apical marginal line weak or interrupted at middle; disc vaguely impressed each side before base. *Elytra*: width elytra/prothorax 1.10 and 1.10. *Measurements*: length 3.4–4.0; width 1.7–1.8 mm.

Types. Holotype ♂ (M.C.Z., Type No. 31,393) and 21 paratypes all from Dobodura, **Papua**, Mar.–July 1944 (Darlington).

Measured specimens. The ♂ holotype and 1 ♀ paratype.

Notes. Most specimens of the type series were taken in flood water in rain forest after heavy rainfall. The insect evidently inhabits leaf litter and perhaps loose soil in rain forest.

Odontomasoreus humeralis reductus n. subsp.

Description. Similar to typical *humeralis* but smaller, with the basal pale areas of elytra reduced or absent but subapical marks distinct. *Head* 0.62 and 0.62 width prothorax. *Prothorax*: width/length 1.80 and 1.86; base/apex 1.45 and 1.41. *Elytra*: width elytra/prothorax 1.08 and 1.08. *Measurements*: length 3.1–3.5; width 1.5–1.6 mm.

Types. Holotype ♂ (M.C.Z., Type No. 31,394) and 6 paratypes from Hollandia, **West N. G.,** July–Sept. 1944 (Darlington). Additional paratypes from **N-E. N. G.**: 1, Astrolabe Bay, 1898 (Biró); 5, Aitape, Aug. 1944 (Darlington).

Measured specimens. The ♂ holotype and 1 ♀ paratype from Hollandia.

Genus *ANAULACUS* Macleay

Macleay 1825, Annulosa Javanica, p. 22.
Csiki 1932, Coleop. Cat., Carabidae, Harpalinae 7, p. 1292 (see for additional references).
Jedlicka 1963, Ent. Abhandlungen 28, p. 286.

Diagnosis. See preceding *Key to genera.*

Description. None required here.

Type species. Anaulacus sericeipennis Macleay, of Java.

Generic distribution. Tropical **Asia** to the **Philippines** and **New Guinea**; **South Africa**.

Notes. One species (in fact, only 1 individual) of this genus has been taken in New Guinea.

Anaulacus siamensis Chaudoir

Chaudoir 1876, Bull. Soc. Nat. Moscow 51, Part 2, p. 25.
?*sterbai* Jedlicka 1934, Sbornik Ent. Odd. Nar. Mus. Prague 1934, p. 119.
?*kendengensis* Louwerens 1952, Treubia 21, p. 215.

Description (for recognition only). With characters of genus; form (Fig. 34) of *Aephnidius* but antennae relatively short; reddish piceous without well defined markings. *Head* 0.66 width prothorax. *Prothorax*: width/length 1.74; base/apex 1.34. *Elytra*: width elytra/prothorax 1.08. *Measurements*: length *c.* 4.5; width *c.* 1.9 mm.

Type. From **Siam**; in Oberthür Coll., Paris Mus. (not seen).

Occurrence in New Guinea. **West N. G.**: 1, Geelvink Bay, 1878 (Raffray & Maindron, Paris Mus.).

Notes. This individual is identified from description and from notes, made at the British Museum in 1947–1948, on a specimen from the Andaman Islands identified as *siamensis* by Andrewes. The unique type of *sterbai*, from Malinao, Tayabas, Philippine Is., is in the British Museum too; it does not differ significantly from the Andaman *siamensis*. I have a paratype of *kendengensis* from Java, and it too is very close to *siamensis*. All these names probably apply to one species that ranges from the southeastern corner of **Asia** to the **Philippines** and **New Guinea**, but the material seen is too limited to justify a final decision.

Genus *AEPHNIDIUS* Macleay

Macleay 1825, Annulosa Javanica, p. 23.
Csiki 1932, Coleop. Cat., Carabidae, Harpalinae 7, p. 1288 (see for additional references and list of species).
Jeannel 1949, Coléop. Carabiques de la Région Malgache, Part 3, p. 861.
Jedlicka 1963, Ent. Abhandlungen 28, p. 284.

Diagnosis. See preceding *Key to genera.*

Description. None required here.

Type species. Aephnidius adelioides Macleay (below).

Generic distribution. All principal tropical and some adjacent warm-temperate areas of **world**.

Notes. A single widely distributed species of the genus occurs in New Guinea.

Aephnidius adelioides Macleay

Macleay 1825, Annulosa Javanica, p. 23, pl. 1, fig. 7.
Andrewes 1930, Cat. Indian Insects, Part 18, Carabidae, p. 11.
Csiki 1932, Coleop. Cat., Carabidae, Harpalinae 7, p. 1288 (see for synonymy and additional references).

Description. None required here; length ± 6 mm.

Type. From **Java**; in British Mus. (seen).

Occurrence in New Guinea. Widely distributed: 29 specimens from **Papua** (including Dobodura), **N-E. N. G.,** and **West N. G.,** at low and moderate altitudes, up to 1200 m (at Wau).

Notes. This species ranges from **SE. Asia**, **Japan**, and **Formosa** to northern **Australia**, east to the **Philippines**, **New Britain**, and **New Ireland**. Seven specimens from Wau and 1 from near Hollandia are labeled as taken in light traps.

Genus *CAPHORA* Schmidt-Goebel

Schmidt-Goebel 1846, Faunula Coleop. Birmaniae, p. 91.
Csiki 1932, Coleop. Cat., Carabidae, Harpalinae 7, p. 1293 (see for additional references).
Jedlicka 1963, Ent. Abhandlungen 28, p. 288.

Diagnosis. Very small Anaulacini (under 3 mm); characterized in the preceding *Key to Genera* of the tribe.

Description. None required here.

Type species. Caphora humilis Schmidt-Goebel (below).

Generic distribution. SE. **Asia**, **Sumatra**, **Java**, the **Philippines**, **New Guinea**, and Cape York, **Australia** (see following species).

Caphora humilis Schmidt-Goebel

Schmidt-Goebel 1846, Faunula Coleop. Birmaniae, p. 91, pl. 3, fig. 8a-b.
Csiki 1932, Coleop. Cat., Carabidae, Harpalinae 7, p. 1293 (see for additional references).
Jedlicka 1963, Ent. Abhandlungen 28, p. 289.

Description. None required here. The very small size distinguishes this species from all other members of the tribe found in the region in question. Length *c.* 2.5 mm.

Type. From Burma; should be in Prague Mus. (not seen).

Occurrence in New Guinea. **Papua**: 1, Brown River, May 24, 1956 (E. J. Ford, Jr., Bishop Mus.), in light trap.

Notes. This species is recorded from **India** and **Burma** to **Sumatra** and **Java** and occurs also on the tip of Cape York, **Australia** (collected by me in 1958). My Cape York specimens were found in the Lockerbie rain forest, in leaf litter mixed with bird droppings under a large tree in which colonial birds had nested. The beetles were in company with *Perigona nigriceps*, which is often carried by commerce, and this suggests that *Caphora* too may sometimes be carried by man.

Tribe CYCLOSOMINI

This is another small tribe, represented in all the warmer regions of the world. The name to use for it is doubtful but not worth detailed discussion here. The members of the tribe, although apparently related to Anaulacini, are superficially *Lebia*-like but differ from *Lebia* in having very long tibial spurs. The only genus of the tribe that occurs in New Guinea is *Sarothrocrepis*.

Genus *SAROTHROCREPIS* Chaudoir

Chaudoir 1876, Bull. Soc. Nat. Moscow 51, Part 2, p. 76.
Csiki 1932, Coleop. Cat., Carabidae, Harpalinae 7, p. 1302 (see for synonymy, additional references, and list of species).
Jedlicka 1963, Ent. Abhandlungen 28, p. 290.

Diagnosis. See under tribe.

Description. None required here.

Type species. *Carabus corticalis* Fabricius, of Australia.

Generic distribution. Represented in **Australia** by numerous, diverse species; 1 species group extends to **New Guinea**, some **Lesser Sunda Islands**, **Celebes**, and the **Philippines**.

Notes. Although most other genera of this tribe are (I think) ground-living, *Sarothrocrepis* is arboreal. Many Australian species live on the trunks of *Eucalyptus* trees, but a few live in foliage, as does the single New Guinean species. The tarsal claws tend to vary with habitat. In the foliage-living New Guinean species and also its immediate Australian relatives, each claw has several long teeth. In some Australian tree-trunk-living forms, the claw teeth are shorter or irregular.

Sarothrocrepis papua n. sp.

Description. Form as in Figure 35; irregular brownish yellow, elytra with variable post-median dark brown mark usually irregularly triangular or M-shaped; reticulate microsculpture isodiametric on front, scarcely or slightly transverse on pronotum, more transverse on elytra. *Head* 0.67 and 0.67 width prothorax. *Prothorax*: width length 1.45 and 1.50; base/*head* 1.41 and 1.41 (apex of prothorax too rounded for exact measurement); margins moderate anteriorly, much wider posteriorly (as usual in genus), each with seta at basal angle and another *c.* ⅓ from apex; base finely margined, apical marginal line interrupted at middle; median line lightly impressed, subapical transverse impression weak, subbasal transverse impression and posterior-lateral impressions slight. *Elytra*: width elytra prothorax 1.52 and 1.48; striae deeply impressed, not punctate; a seta-bearing puncture at base each 2nd interval, usually an inconspicuous puncture on inner edge each 3rd interval near apex, and sometimes an apparent minute puncture on outer edge 3rd interval *c.* ⅓ from base. *Inner wings* full. *Lower surface and legs*: no noteworthy characters except tarsal claws each with 4 long teeth, the inner one smaller and sometimes difficult to see. *Secondary sexual characters*: ♂ front tarsi slightly dilated, 3 segments 2-seriately squamulose (4th segments with soles of non-sexual adhesive hairs in both sexes); ♂ (not ♀) apical ventral segment deeply acutely notched at middle; 1 seta each side apex last ventral segment in both sexes. *Measurements*: length 4.6–6.4 (usually 5.0–5.5); width 2.3–3.0 (usually *c.* 2.7) mm.

Types. Holotype ♂ (M.C.Z., Type No. 31,395) and 120 paratypes all from Dobodura, **Papua**, Mar.–July 1944 (Darlington).

Additional material. Thirteen specimens from other localities in **Papua**, **N-E. N. G.**, and **West N. G.**; and 2 specimens from Cape Gloucester, **New Britain**, Jan.–Feb. 1944 (Darlington).

Measured specimens. The holotype and 1 ♀ paratype.

Notes. *Sarothrocrepis papua* resembles S. *fasciata* Macleay of North Queensland, Australia, but is larger, with prothorax narrower and elytral markings slightly different. Three similar species occur in the Malay Archipelago. S. *m-migrum* Jordan, from Tenimber (and in Andrewes Coll. also from Sumbawa, Sumba, and Andonare Is.), has prothoracic margins narrower than *papua* and the dark M-mark usually better defined (but the mark is variable in *papua*). S. *javanica* Van Emden has prothoracic margins narrower and basal impressions of pronotum more linear. And S. *andrewesi* Jedlicka, of the Philippines, has the elytral marks different (3 dark stripes on yellow background) and basal impressions of pronotum better defined, sublinear. These names may all be based on forms of one widely distributed variable species, but I prefer to treat them as separate species for the time being.

S. *papua* was very common in under-story foliage of rain forest at Dobodura, especially in clumps of dead leaves still attached to low branches. It is probably mainly diurnal, although I have seen 2 specimens taken in light traps.

Tribe LEBIINI

Csiki 1932, Coleop. Cat., Carabidae, Harpalinae 7, p. 1305 ff. (see for synonymy and additional references).
Jedlicka 1963, Ent. Abhandlungen (Dresden) 28, p. 295.
Habu 1967, Fauna Japonica, Carabidae, Truncatipennes Group, p. 57.
Lebiidae Jeannel 1942, Faune de France, Coléop. Carabiques, Part 2, p. 1017.
Jeannel 1949, Coléop. Carabiques de la Région Malgache, Part 3, p. 876.
Lebiinae Basilewsky 1953, Exploration Parc National l'Upemba, Fasc. 10, Carabidae, p. 184.

Lebiini are medium sized and small Carabidae usually recognizable by general appearance. The elytra are usually (but not always) obliquely truncate or sinuate-truncate at apex (and often spined too), and the insects have additional technical characters, including genitalic ones, given by authors cited above.

The tribe is a very large one. It is best represented in the tropics and includes a large proportion of arboreal forms especially in the tropics.

Arboreal Lebiini divide into two ecologic groups, one living on tree trunks and the other in foliage. The tree-trunk dwellers are numerous in rain forest and some occur on fallen trees and logs as well as the trunks and larger branches of living trees. Some are nocturnal, some diurnal. Some of them can be trapped under sacking tied around tree trunks or laid over logs. Lebiini living on tree trunks and logs in New Guinea include *Stenotelus*, *Miscelus*, *Minuthodes*, *Catascopus*, *Pericalus*, *Coptodera* (some), *Mochtherus*, and *Stricklandia*. (Other lebiine genera, especially *Philophloeus*, *Agonochila*, and Australian *Demetrida*, live on the trunks of *Eucalyptus* trees in more open woodland in Australia.) The foliage dwellers in New Guinean rain forest include *Aristolebia*, *Lebia*, *Dolichoctis*, *Celaenephes*, and especially New Guinean *Demetrida*. (The ecology of *Demetrida* is discussed in more detail in *Notes* under the genus.) Different foliage-inhabiting Lebiini in New Guinea probably inhabit different special niches. Some species are commonly taken by sweeping under-story plants in rain forest but other species are not, and these may live at higher levels in the trees. They may be difficult to collect except when trees are felled, unless they fly to light. Besides the arboreal forms, a few Lebiini in New Guinea (and relatively more in colder climates) live on the ground, especially in leaf litter in rain forest. In New Guinea, these include some *Coptodera*, probably *Syntomus* and *Microlestes* and *Apristus*, and certainly *Anomotarus* and *Nototarus*. They can be collected in small numbers, laboriously, by sifting or in Berlese traps, or in larger numbers and more easily by washing out debris and loose earth from the forest floor or by sorting and washing flood debris from rain forest.

Most Lebiini are winged and many of them fly actively to escape danger or to disperse (see *Notes* under *Catascopus*), and some, presumably mostly nocturnal species, fly to light at night. The only known New Guinean lebiine with atrophied wings is *Nototarus papua*.

Although Lebiini are most numerous and diverse in the tropics, the tribe as a whole is virtually cosmopolitan. A few genera, including *Lebia* and *Coptodera*, are very widely distributed too, but most other genera have restricted distributions.

Thirty genera of Lebiini are known in New Guinea and at least 3 additional genera probably occur. Many of the genera are shared with, better represented in, and probably derived from the Oriental Region. These include *Lebia*, *Catascopus*, *Coptodera*, *Dolichoctis*, and more than a dozen smaller genera. Genera shared mainly with and perhaps derived from Australia are fewer but include *Agonochila*, *Trigonothops*, *Phlococarabus*, *Anomotarus*, *Nototarus*, and especially *Demetrida*. The genera *Minuthodes*, *Stricklandia*, and *Miscelus* now center on New Guinea and may have originated there. The only lebiine genus actually confined to New Guinea is monotypic *Minuphloeus*.

The genus *Demetrida* seems to be in the

very midst of an explosive evolutionary radiation, which is discussed under the genus. I know no other case quite like it among Carabidae.

The following key to the genera of Lebiini of New Guinea is practical, not phylogenetic. Genera that occur together in the key are not necessarily closely related, and the key is designed for *only* the New Guinean species of some genera. I have used form of the whole insect as a key character of some genera. The form *is* characteristic in some cases, and the form of the whole is surely no less important than the form of a part.

After the key, the genera are treated in the order of the *Coleopterorum Catalogus* (Csiki 1932), not in the order in which they are keyed out.

An enormous supposed lebiine, *Holoponerus godeffroyi* (Fairmaire), has been described from New Britain. I do not know this insect, but I think it is probably not a member of the Lebiini but of the tribe Helluodini, under which I shall discuss it in more detail.

KEY TO GENERA OF LEBIINI OF NEW GUINEA

1. Fourth segments of hind tarsi deeply emarginate, with lobes ½ or more total length of segment 2
– Fourth segments of hind tarsi more shallowly emarginate or subtruncate 10
2. Form usually broad *Lebia*-like (Figs. 37–41); base of prothorax ± lobed; upper surface not pubescent; tarsi not pubescent above; ♂ middle tibiae excised on inner edge near apex 3
– Form not *Lebia*-like, usually more slender; base of prothorax often (not always) without lobe; tarsi often (not always) pubescent above; ♂ middle tibiae usually not excised (but tuberculate-serrate in many *Demetrida*) 4
3. Outer-apical angles of elytra sharply formed *and* prothorax ± hemispheric; ♂ middle tibiae with 2 excisions on inner edge near apex (p. 83) ..... *Aristolebia*
– Outer-apical angles of elytra either rounded or sharply formed, but if latter, prothorax not hemispheric (in New Guinean species); ♂ middle tibiae with 1 excision on inner edge near apex (p. 85) ..... *Lebia*
4. Small (4–4.5 mm); prothorax trapezoidal, widest at base (Fig. 87) (p. 134) ..... *Peliocypas*
– Larger; prothorax usually not as described 5
5. Upper surface coarsely rugose and pubescent; prothorax strongly lobed at base; (form as in Fig. 42; length *c.* 8 mm) (p. 89) ..... *Lachnoderma*
– Upper surface not coarsely rugose; pubescent or not, but if pubescent, prothorax not lobed at base 6
6. Fifth elytral intervals with coarse seta-bearing puncture near base; prothorax with (very short) basal lobe (form as in Fig. 95; length *c.* 8–9 mm) (p. 139) ..... *Anchista*
– Fifth elytral intervals without coarse puncture near base; prothorax usually (not always) without basal lobe 7
7. Form (Figs. 97–109) usually slender; apex of elytra sinuate-truncate or angulate or spined but not broadly and strongly rounded; tarsi pilose above (p. 140) ..... *Demetrida*
– Form usually less slender; apex of elytra broadly and strongly rounded or weakly sinuate-truncate with outer angles broadly rounded; tarsi above pilose or not 8
8. Prothorax with (slight) basal lobe; tarsi not pilose above (p. 184) ..... *Trigonothops*
– Prothorax without basal lobe (but base slightly oblique near angles); tarsi usually pilose above (pilosity slight in some *Parena*) 9
9. Upper surface not pubescent (p. 138) ..... *Parena*
– Upper surface pubescent (p. 140) ..... *Endynomena*
10. Form (Fig. 37) characteristic, broadly oval with outer elytral angles sharply formed; ♂ middle tibiae with 2 excisions on inner edge near apex; (length *c.* 9.5–11.0 mm—smaller species of same genus key out in couplet 3) (p. 83) ..... *Aristolebia*
– Form not as above; ♂ middle tibiae usually not 2-excised 11
11. Form (Fig. 36) characteristic; small (*c.* 4 mm or less); upper surface pubescent; prothorax with extra anterior-lateral setae; brown with single broad transverse dark band across elytra (p. 82) ..... (*Somotrichus*)
– Not as above in one or more ways 12
12. Very small (less than 4 mm); color black or (rarely) transversely fasciate 32
– Larger *or*, if length less than 4 mm, with color pattern of longitudinal lines 13
13. Form (Fig. 88) characteristic, slender, with rounded elytral apices; mentum without tooth and claws not toothed; (black; length *c.* 7 mm) (p. 135) ..... *Celaenephes*
– Not as above 14

14. Claws simple, not toothed; size usually large; color often metallic ... 15
– Claws each with several teeth; size often (not always) smaller; color rarely metallic ... 17
15. Form (Fig. 45) characteristic, slender, subcylindric, with long genae and small eyes, and with rounded-truncate elytral apices; often (not always) only 1 seta over eye; (length 9.5–14.5 mm) (p. 91) ... *Miscelus*
– Form not as above; 2 setae over each eye ... 16
16. Labrum long, notched at apex; size larger (8–22 mm); color metallic or rarely brown, without geometric marks (p. 101) ... *Catascopus*
– Labrum shorter, not notched; smaller (7–8 mm in New Guinean species); elytra with geometric marks (p. 110) ... *Pericalus*
17. Mentum not toothed ... 18
– Mentum toothed ... 19
18. Third elytral intervals with 2–4 dorsal punctures, but if 2, not as described below; ♂ middle tibiae usually excised on inner edge before apex (p. 110) ... *Coptodera*
– Third elytral intervals with 2 minute non-seta-bearing punctures behind middle, or without recognizable dorsal punctures; ♂ middle tibiae not excised (p. 124) ... *Dolichoctis*
19. Elytra spined ... 20
– Elytra not spined ... 21
20. Prothorax without extra lateral setae; form (Fig. 44) not strikingly broad (p. 90) ... *Stenotelus*
– Prothorax with many extra lateral setae; form (Fig. 86) strikingly broad (p. 132) ... *Stricklandia*
21. Form (Fig. 43) characteristic, broad, with broadly rounded elytral apices; (dull black; length *c.* 10–11 mm) (p. 90) ... *Sinurus*
– Not as above ... 22
22. Elytral apices very strongly sinuate-truncate; (slender; color green, blue, or coppery; length in New Guinea *c.* 8–9 mm) (p. 94) ... *Holcoderus*
– Not as above ... 23
23. Form (Figs. 47–58) characteristic, very broad, with wide head but relatively small eyes, prothorax usually *c.* 2× wide as long, elytra short-quadrate; (pubescence and color diverse; length *c.* 4–6.5 mm) (p. 95) ... *Minuthodes*
– Form not as above (if *c.* similar but labrum notched, see *Minuphloeus*, below) ... 24
24. Labrum notched at apex; pronotum with numerous lateral setae; (shining black; length 7.5–8.0 mm) (p. 117) ... *Minuphloeus*
– Labrum not notched; pronotum with 2 lateral setae each side ... 25
25. Third elytral intervals with 3 or 4 dorsal punctures *or* (in some *Agonochila*) these punctures lost amid other coarse punctation and short pubescence ... 26
– Third elytral intervals with 2 or rarely 1 dorsal punctures ... 27
26. Surface conspicuously short-pubescent and (at least on elytra) roughened (p. 118) ... *Agonochila*
– Surface not distinctly pubescent, not roughened; (3rd elytral intervals with 3 punctures) (p. 122) *Oxyodontus*
27. Labial palpi slender ... 28
– Labial palpi with apical segments ± widened, usually subtriangular ... 29
28. Third elytral intervals 2-punctate; pronotum setulose (p. 122) ... *Mochtherus*
– Third elytral intervals 1-punctate; pronotum not setulose (p. 123) ... (*Mochtheroides*)
29. Antennae and tarsi relatively short and thick; ♂ middle tibiae arcuate and with shallow excision at middle of length; (color brown; length *c.* 8 mm) (p. 138) ... (*Plochionus*)
– Antennae and tarsi more slender; ♂ middle tibiae not as described ... 30
30. Eyes abruptly prominent, genae short and forming *c.* right angles with neck (p. 183) *Phlococarabus*
– Eyes less prominent, genae longer and forming obtuse angles with neck ... 31
31. Side pieces of metasternum long; inner wings full; color pattern usually present (p. 186) *Anomotarus*
– Side pieces of metasternum scarcely longer than wide; inner wings vestigial; color *c.* uniform brownish black (p. 185) *Nototarus*
32. Claws simple, not toothed; (mentum with entire tooth) (p. 137) *Apristus*
– Claws each with several (sometimes weak) teeth ... 33
33. Mentum with (emarginate) tooth (p. 135) *Syntomus*
– Mentum not toothed (p. 136) ... *Microlestes*

(Genus *SOMOTRICHUS* Seidlitz)

Seidlitz 1887, Fauna Baltica, 2nd ed., Gattungen, p. 7.

Mateu 1963, Ann. Mus. Civ. Genoa 74, pp. 131 ff. (See also references under following species)

Diagnosis. Form as in Figure 36, small,

subparallel, with eyes rather small and widely separated (in this tribe); upper surface pubescent; pronotum with several strong setae each side; wings full; 4th hind-tarsal segment weakly emarginate.

Description. None required here.

Type species. Carabus elevatus Fabricius (below).

Generic distribution. One species has been dispersed over the warmer parts of the **world** by man. A second species is known only from Madagascar.

(*Somotrichus elevatus* (Fabricius))

Fabricius 1787, Mantissa Insectorum 1, p. 198 (*Carabus*).
Csiki 1932, Coleop. Cat., Carabidae, Harpalinae 7, p. 1308 (see for synonymy and additional references).
Jeannel 1942, Faune de France 40, Coléop. Carabiques, Part 2, p. 1032.

Description (for recognition only). With characters of genus; brown with broad, regular, darker brown fascia across middle of elytra; length *c.* 3.5–4.0 mm.

Types. From tropical **America**; now in Hunter Coll. (Glasgow) and Fabricius Coll. (Kiel) (not seen).

Occurrence in New Guinea. Not recorded but may occur.

Notes. Somotrichus elevatus is supposedly native in tropical **Africa** but has been carried over much of the world by commerce. It is often found in seaport cities. In the Malay Archipelago it has been collected on **Java**, **Celebes**, and Batjan ("Batchian") in the **Moluccas**, and I have a specimen before me from Peleliu in the **Palau Is.** Its occurrence in New Guinea is therefore likely. It has not yet been found in Australia.

Genus *ARISTOLEBIA* Bates

Bates 1892, Ann. Mus. Civ. Genoa 32, p. 428.
Csiki 1932, Coleop. Cat., Carabidae, Harpalinae 7, p. 1308 (see for additional references, synonymy, and list of species).
Jedlicka 1963, Ent. Abhandlungen 28, p. 311.

Diagnosis. Similar to large *Lebia* with prothorax *c.* hemispheric and outer elytral angles sharply defined; wings full; 4th segments middle and hind tarsi emarginate or lobed (see following *Notes*); claws with 9–11 long teeth in larger species but only 5–7 teeth in smaller species; ♂ middle tibiae each with 2 (not 1 as in *Lebia*) excisions close together on inner edge near apex; most other characters including those of mouthparts as in *Lebia.*

Description. None required here.

Type species. Aristolebia quadridentata Bates, of Burma.

Generic distribution. Southern **India** (specimens in M.C.Z.), southern **China**, **Burma**, etc., to the **Philippines**, **New Guinea**, and the tip of Cape York, **Australia** (see under *A. wau*, below).

Notes. The smaller species described below are in some ways transitional between *Aristolebia* and *Lebia*, but *Aristolebia* seems to me to be a natural group worth distinguishing from *Lebia*, which is an enormous, unwieldy genus. The tarsal lobes in *Aristolebia* vary, but the variation shows continuity. In large Asiatic species of the genus the 4th segments of the hind and middle tarsi are relatively weakly emarginate. In the large New Guinean species (*papua*) the lobes of the 4th segments are rather short on the hind but longer on the middle tarsi. And in the smaller New Guinean species the lobes of the 4th segments are long, more than ½ the segments' length even on the hind tarsi, and are relatively longer in *capitis* than in *wau.*

In New Guinea, *Aristolebia* occurs chiefly at mid-altitudes. It is probably arboreal (in rain forest) and probably diurnal, although a few individuals have been taken in light traps at Wau.

KEY TO SPECIES OF *ARISTOLEBIA* OF NEW GUINEA

1. Larger, 9.5–11.0 mm (p. 84) ..... *papua*
– Smaller, 5.5–6.5 mm 2
2. Entirely yellow or brownish yellow; sutural angles distinct and usually subdenticulate (p. 84) ..... *wau*
– Elytra dark with broad stripes or spots pale; sutural angles (narrowly) rounded (p. 85) ..... *capitis*

Aristolebia papua n. sp.

Description. With characters of genus; form as in Figure 37; black, sides of pronotum broadly and of elytra narrowly pale, elytra with variable pale marks or sometimes wholly dark, lower surface, mouthparts, and appendages reddish brown; rather shining, microsculpture as described below. *Head* 0.76 and 0.73 width prothorax; front irregularly slightly impressed and rugulose anteriorly, rather sparsely punctulate, with *c.* isodiametric microreticulation especially posteriorly. *Prothorax*: width/length 1.67 and 1.60; base/apex *c.* 1.95 and 1.98 (figures approximate because anterior angles not defined); margins narrow anteriorly, broad posteriorly, each with seta-bearing puncture at basal angle and before middle; base and apex with entire impressed marginal lines; disc slightly transversely rugulose, sparsely punctulate, in part lightly microreticulate. *Elytra* ample; width elytra/prothorax 1.70 and 1.67; outer-apical and sutural angles acute and denticulate; striae entire, impressed, faintly or not punctulate; intervals with slightly transverse microreticulation and sparse fine punctulation, 3rd with 2 dorsal punctures on outer edge *c.* ⅓ from base and less than ¼ from apex (slightly variable in position). *Legs*: 4th segments middle and hind tarsi as in Figure 166; claws broadly triangular, each with *c.* 10 long teeth. *Secondary sexual characters*: ♂ front tarsi scarcely dilated but with narrow, irregularly 2-seriate squamules; ♂ middle tibiae 2-excised; ♂ with 2, ♀ *c.* 4 setae each side before apex last ventral segment. *Measurements*: length 9.5–11.0; width 4.5–5.3 mm.

Types. Holotype ♂ (Bishop Mus.) and 17 paratypes (some in M.C.Z., Type No. 31,396) from Wau, Morobe Dist., **N-E. N. G.,** 1100 to 1300 m, dates in Jan., Feb., Apr., May, Aug., and Sept., 1961–1963 (Sedlaceks) (holotype, 1200–1300 m, May 7, 1963); and additional paratypes as follows. **N-E. N. G.**: 1, Swart Vy., Karubaka, 1500 m, Nov. 11, 1958 (Gressitt). **West N. G.**: 1, "Humbolt Bay" (N. A. Doherty, British Mus.).

Additional material. **Papua**: 1, W. District, Oriomo Govt. Station, Oct. 26–28, 1960 (Gressitt).

Measured specimens. The ♂ holotype and 1 ♀ paratype from Wau.

Notes. This may prove to be a geographic form of *Aristolebia davaonis* (Heller) of the Philippines, but the color is different (*davaonis* has the prothorax rusty red, not black) and other details are probably different, although I cannot be sure about them from Heller's description of his single specimen. A form of *davaonis*, or a related species, has been found also on Salajar Is. off Celebes (specimens received from Louwerens).

The single individual from Papua is the only one in the New Guinean series with wholly dark elytra, and it differs slightly from the type series in other ways. It may prove to be a distinguishable geographic form. Other variation in elytral pattern is individual in the series from Wau.

Aristolebia wau n. sp.

Description. With characters of genus; form *c.* as in preceding species (*papua*); usually entirely reddish yellow, rarely with faint dusky areas especially at base of elytra; upper surface with light, irregular, *c.* isodiametric or slightly transverse microreticulation. *Head* 0.80 and 0.77 width prothorax. *Prothorax*: width/length 1.56 and 1.67 (difference due partly to slight abnormal extension of basal lobe in the first individual); lateral margins wide, flattened or weakly reflexed especially posteriorly, each with usual 2 setae; base and apex with entire marginal lines, but apical line weak at middle; disc irregularly ± transversely rugulose. *Elytra* ample, convex; width elytra/prothorax 1.72 and 1.76; outer-apical angles obtuse but well defined and sometimes subdenticulate, sutural angles slightly dehiscent, ± subdenticulate; striae entire, impressed, not distinctly punctulate;

intervals convex, 3rd with 2 inconspicuous punctures on outer edge before middle and *c.* ¼ from apex. *Legs*: 4th segments hind tarsi deeply emarginate but lobes shorter than usual in *Lebia*, 4th segments of middle tarsi with longer lobes; claws each with *c.* 7 long teeth. *Secondary sexual characters*: ♂ front tarsi with slender squamae probably in 2 series but often disarranged; ♂ middle tibiae with 2 excisions close together on inner edge near apex; ♂ with apparently 2, ♀ 3 setae each side near apex last ventral segment. *Measurements*: length 5.5–6.5; width 2.7–3.2 mm.

Types. Holotype ♂ (Bishop Mus.) and 22 paratypes (some in M.C.Z., Type No. 31,397) all from Wau, Morobe Dist., **N-E. N. G.,** 1100–1500 m, dates in Jan., Feb., Mar., Apr., May, June, Sept., Nov., Dec., 1961–1963 (Sedlaceks).

Measured specimens. The ♂ holotype and 1 ♀ paratype.

Notes. I took a single ♀ of this species at Lockerbie, near the tip of Cape York, in January 1958, thus extending the known range of *Aristolebia* to **Australia**.

Aristolebia capitis n. sp.

Description. With characters of genus; form and characters as in *wau* (above) except slightly wider; elytra dark with *either* large humeral and smaller subapical marks reddish yellow *or* very broad reddish yellow stripes running from humeri to apex. *Head* 0.72 and 0.72 width prothorax. *Prothorax*: width/length 1.64 and 1.59. *Elytra*: width elytra/prothorax 1.60 and 1.69; outer-apical angles sharply defined but sutural angles narrowly rounded. *Legs* with 4th segments middle and hind tarsi strongly lobed (Fig. 167); claws each with 5 long teeth and sometimes a 6th (inner) tooth that is difficult to see. *Measurements*: length *c.* 6.0–6.5; width 3.1–3.3 mm.

Types. Holotype ♂ (A.M.N.H.) and 1 ♀ paratype (M.C.Z., Type No. 31,398) both from Mar Village, west Vogelkop, **West N. G.,** Nov.–Dec. 1944 (V. S. Mallory).

Notes. The rounding of the sutural angles and the small number of claw-teeth of *capitis* are *Lebia*-like, but the form is that of an *Aristolebia* (some *Lebia* approach this form too) and the ♂ middle tibiae are decisively 2-excised.

Genus *LEBIA* Latreille

Latreille 1802, Hist. Nat. Crustaceorum et Insectorum 3, p. 85.
Csiki 1932, Coleop. Cat., Carabidae, Harpalinae 7, p. 1310 (see for additional references, synonymy, subgenera, and list of species).
Jeannel 1942, Faune de France, Coléop. Carabiques, Part 2, p. 1028.
Jedlicka 1963, Ent. Abhandlungen 28, p. 314.

Diagnosis. See *Key to Genera of Lebiini of New Guinea.*

Description (characters of New Guinean species only). Form broad but variable (Figs. 38–41); coloration variable, upper surface not pubescent. *Head*: eyes prominent, genae short; 2 setae over each eye; clypeus transverse, truncate or broadly slightly emarginate, with 1 seta-bearing puncture each side; labrum ± transverse, sometimes slightly rounded anteriorly, 6-setose; mentum strongly toothed; ligula rather broad, 2-setose; paraglossae attached to ligula, broad, setose. *Prothorax* ± lobed at base, anterior angles broadly rounded (so base/apex ratio not determinable); lateral margins broad posteriorly, ± reflexed, each with 2 setae, at or near basal angle and before middle; disc with usual impressed middle line, weak (or obsolete) anterior and deeper posterior transverse impressions, and weak transverse strigulation. *Elytra* wide but variable in form; striae entire; 3rd interval 2-punctate on outer edge. *Inner wings* full. *Lower surface* with some short, often inconspicuous pubescence. *Legs*: 4th segments middle and hind tarsi very deeply emarginate, with long lobes; 5th segments with accessory setae; claws with 4–6 long teeth. *Secondary sexual characters*: ♂ anterior tarsi not or scarcely dilated, with slender squamae in 2 series, often disarranged; ♂ middle tibiae with 1 small deep

excision on inner edge just before apex; ♂ with apparently 1 or 2 (rarely 3), ♀ 2 or more seta-bearing punctures each side near apex last ventral segment (but these punctures often difficult to identify amid other punctures and pubescence).

Type species. Carabus haemorrhoidalis Fabricius (= *Lebia marginata* (Fourcroy)), of Europe.

Generic distribution. Nearly **world-wide** except absent in some cold regions and on some remote islands. Species are numerous in most tropical regions but are relatively few (7) in New Guinea and still fewer in Australia. This suggests that the genus has entered the Australian Region recently, from the direction of tropical Asia.

Notes. The New Guinean representatives of this huge, widely distributed genus are probably all arboreal. Some or all of them live in the lower foliage of rain forest. They are probably diurnal, being rarely taken in light traps.

KEY TO THE SPECIES OF *LEBIA* OF NEW GUINEA

1. Outer-apical angles of elytra well defined 2
– Outer-apical angles of elytra rounded 3
2. Color piceous; form of *Endynomena* (Fig. 38) (p. 86) ..... *endynomena*
– Color yellow; form more of typical *Lebia* (Fig. 39) (p. 86) ..... *externa*
3. Elytra with conspicuous black "anchor" mark on testaceous background, or dark with anterior lunules and apex testaceous (p. 87) ..... *karenia*
– Elytra differently marked or not marked 4
4. Elytra dark with large common cordate area testaceous (p. 87) ..... *cordifer*
– Not thus marked 5
5. Brown, elytra sometimes vaguely darker or with vague discal cloud but not sharply bicolored, *and* head and pronotum not or only lightly microreticulate (p. 88) ... *papuella*
– *Either* bicolored *or* with head and pronotum heavily microreticulate 6
6. Not sharply bicolored, brown, elytra often with disc darker; head and pronotum heavily microreticulate (p. 88) ..... *barda*
– Bicolored, head and prothorax red-testaceous, elytra entirely black or piceous; head and pronotum not or lightly microreticulate (p. 89) ..... *insularum*

Lebia endynomena n. sp.

Description. With characters of genus; form (Fig. 38) more of *Endynomena* than of typical *Lebia*; piceous, reflexed margins of prothorax and (narrowly) of elytra translucent testaceous, appendages reddish testaceous; shining, reticulate microsculpture absent or faint on front and pronotal disc, distinct and strongly transverse on elytra. *Head* 0.82 width prothorax; front weakly impressed at middle and on each side anteriorly, irregularly rather sparsely punctate. *Prothorax* subcordate; width/length 1.69; base/apex not determinable; base and apex margined. *Elytra c.* ¾ wider than prothorax, narrowed anteriorly; width elytra prothorax 1.72; apices slightly obliquely sinuate-truncate with outer angles well defined and almost subdenticulate and sutural angles irregularly narrowly rounded; striae impressed, not distinctly punctulate. *Secondary sexual characters* as for genus, including ♂ middle tibiae with 1 deep excision on inner edge just before apex; ♂ with 2 or 3 seta-bearing punctures before apex each side last ventral segment (punctures unsymmetric in the single specimen); ♀ unknown. *Measurements*: length *c.* 7.7; width *c.* 3.9 mm.

Type. Holotype ♂ (Bishop Mus.) from Bubia, Markham Vy., **N-E. N. G.,** 50 m, Sept. 19, 1955 (Gressitt); the type is unique.

Notes. This species differs in form and appearance from any other *Lebia* known to me, but the generic characters, including the excision of the ♂ middle tibiae, are clearly those of *Lebia.*

Lebia externa n. sp.

Description. With characters of genus; form as in Figure 39; reddish yellow, appendages slightly paler; rather shining, reticulate microsculpture absent or faint on front and pronotal disc, distinct and transverse on elytra. *Head* 0.92 and 0.92 width prothorax; front weakly impressed at middle and on each side anteriorly, slightly

irregularly punctate. *Prothorax* rather small, not hemispheric but transversely subquadrate with anterior angles broadly rounded; width/length 1.51 and 1.52; base margined, apex not margined at middle; disc rather strongly transversely strigulose and vaguely punctulate. *Elytra* almost 2× wide as prothorax; width elytra/prothorax 1.98 and —; rather strongly narrowed anteriorly; apices obliquely truncate-emarginate with outer angles obtuse but distinct and sutural angles narrowly rounded; striae impressed, not punctulate. *Secondary sexual characters*: ♂ front tarsi with squamae (if present) not easily distinguishable (worn off?); ♂ middle tibiae with 1 deep excision on inner edge just before apex; ♂ with 2, ♀ 4 setae each side near apex last ventral segment. *Measurements*: length 7.0–7.3; width *c.* 3.2–3.4 mm.

Types. Holotype ♂ (Bishop Mus.) from Pindiu, Huon Pen., **N-E. N. G.,** Apr. 20, 1963 (Sedlacek); 1 ♂ paratype (M.C.Z., Type No. 31,399) from Wau, Morobe Dist., Mt. Missim, 880–1050 m, Feb. 8–9, 1963 (Sedlacek); 1 ♀ paratype, Popondetta, **Papua**, 60 m, Sept. 3–4, 1963 (Sedlacek).

Notes. Except for the distinct outer-apical elytral angles, this species resembles large individuals of *Lebia papuella*, described below.

Lebia karenia Bates

Bates 1892, Ann. Mus. Civ. Genoa 32, p. 426.
Andrewes 1933, Ent. Series Indian Forest Records 18, Part 5, pl. 3, fig. 9.

Description (of New Guinean individuals). With characters of genus; form *c.* of typical *Lebia*; head, prothorax, and lower surface usually reddish testaceous (head and prothorax sometimes infuscate), elytra varying from dark with posthumeral lunules and apices testaceous (as figured by Andrewes) to testaceous with broad sutural anchor mark; appendages reddish or testaceous; microreticulation light and irregular on front, isodiametric or slightly transverse on pronotum, more transverse on elytra. *Head* 0.83 and 0.79 width prothorax. *Prothorax* not hemispheric but transverse-subquadrate with anterior angles broadly rounded; width/length 1.54 and 1.61; base margined, apex with marginal line weak or interrupted at middle. *Elytra* less than 2× width prothorax, narrowed anteriorly; width elytra/prothorax 1.83 and 1.84; apices obliquely sinuate-truncate with outer and sutural angles narrowly rounded; striae deep, impunctate. *Measurements*: length 6.0–7.5; width 2.8–3.8 mm.

Types. From **Burma**, in Genoa Mus. (not seen).

Occurrence in New Guinea. Probably throughout **New Guinea** at low altitudes and in the lower mountains up to 1200 m (at Guega W. of Swart Valley); 20 specimens seen, from all 3 political divisions of the island.

Measured specimens. A ♂ from Dobodura, Papua, and ♀ from Torricelli Mts., N-E. N. G.

Notes. My identification of this species is based on comparison with Andrewes' material at the British Museum.

Lebia cordifer n. sp.

Description. With characters of genus (but 5th segments missing from all tarsi); form (Fig. 40) of typical rather narrow *Lebia*; piceous above with clypeus and labrum, side margins of prothorax, narrow reflexed margins of elytra, and large common heart-shaped area on elytra (extending from inside humeri to apical ¼ at 2nd intervals and reaching 6th intervals laterally) testaceous; lower surface and appendages brownish to testaceous; shining, reticulate microsculpture absent or faint on front and on disc of pronotum (but these areas sparsely punctulate), transverse on elytra. *Head* 0.89 width prothorax; eyes large and very prominent; front with V-shaped impression at middle and impressed each side anteriorly. *Prothorax* relatively small, not hemispheric; width/length 1.58; sides strongly rounded, then strongly sinuate just before *c.* acute but blunted posterior angles; base with broad,

strong, truncate lobe, weakly margined; apex subtruncate, not margined at middle. *Elytra* rather narrow but almost 2× width of (small) prothorax, slightly narrowed anteriorly; width elytra/prothorax 1.95; apices obliquely sinuate-truncate, with outer angles broadly and sutural angles narrowly rounded; striae impressed, not distinctly punctulate. *Secondary sexual characters* of ♂ as described for genus; ♂ with 2 setae each side before apex last ventral segment; ♀ unknown. *Measurements*: length *c.* 5.7; width *c.* 2.7 mm.

Type. Holotype ♂ (Leiden Mus.) from Bivak 39 A, Star Rge., **West N. G.,** 1500 m, July 12, 1959 (Neth. New Guinea Exp.); the type is unique.

Notes. This is distinguished from other New Guinean species in the preceding *Key to Species,* but I do not know its real relationships.

Lebia papuella n. sp.

Description. Form of typical *Lebia* with relatively small prothorax; entirely brownish yellow, elytra sometimes with faint darker cloud; shining, reticulate microsculpture *c.* absent on front and on disc of pronotum, present on elytral intervals as transverse impressions not forming regular reticulations. *Head* 0.92 and 0.88 width prothorax; front scarcely impressed. *Prothorax* small, transversely subquadrate; width/length 1.54 and 1.56; basal and apical marginal lines faint or interrupted at middle; disc with anterior transverse impression subobsolete. *Elytra* much wider than prothorax, narrowed anteriorly; width elytra/prothorax 1.92 and 1.91; apices obliquely slightly sinuately truncate, with outer-apical angles broadly and sutural angles more narrowly rounded; striae impressed, not punctate. *Secondary sexual characters* as for genus; ♂ with apparently 2, ♀ 2 or more apical ventral setae each side. *Measurements*: length 4.1–5.5; width 2.0–2.7 mm.

Types. Holotype ♂ (M.C.Z., Type No. 31,400) and 25 paratypes all from Dobodura, **Papua**, Mar.–July 1944 (Darlington).

Additional material. Thirty, from numerous localities in all 3 political divisions of **New Guinea**, from lowlands to 1700 m (above Wau). Some of these specimens are assigned to this species doubtfully.

Measured specimens. The ♂ holotype and 1 ♀ paratype.

Notes. Lebia papuella seems closely related to a species from Queensland, Australia, that I identify as *picipennis* Macleay, but *papuella* has less pronotal microsculpture and less sinuate elytral apices than *picipennis.* Similar (but not identical) undetermined species occur in the Philippines.

Besides the type series, I have one exceptionally large ♀ from Dobodura that seems to be *papuella.* (Exceptional outsize individuals occur in some other, American, species of *Lebia.*) Its proportions and measurements are: head 0.87 width prothorax; prothoracic width/length 1.54; width elytra prothorax 1.94; length 6.5; width 3.3 mm.

My specimens (the types) were taken by sweeping and beating undergrowth and low foliage in rain forest.

Lebia barda n. sp.

Description. With characters of genus; form of typical *Lebia* except prothorax tending toward hemispheric; yellow, elytra with ± distinct common dorsal plagia dark, the dark area sometimes extending almost to sides of elytra; lower surface and appendages yellow; whole upper surface relatively dull, with deeply impressed isodiametric microsculpture becoming slightly transverse on elytra. *Head* 0.81 and 0.81 width prothorax; front with 2 small impressions anteriorly. *Prothorax*: width/length 1.60 and 1.70; base margined; apex not distinctly margined at middle. *Elytra* narrowed anteriorly; width elytra/prothorax 1.80 and —; apices weakly sinuate-truncate, with outer and sutural angles rounded; striae deep, not distinctly punctulate. *Secondary sexual characters* as for genus; ♂ apparently with 2, ♀ 3 setae each side last ventral segment. *Measurements*: length 4.4–5.8; width 2.2–2.8 mm.

Types. Holotype ♂ (M.C.Z., Type No. 31,401) and 2 paratypes from Dobodura, **Papua**, Mar.–July 1944 (Darlington); and additional paratypes as follows. **Papua**: 1, between Laloki R. and Brown R., 25 m, Mar. 16, 1956 (Gressitt); 1, Normanby Is., Wakaiuna, Sewa Bay, Nov. 21–30, 1956 (W. W. Brandt, Bishop Mus.). **N-E. N. G.**: 1, Busu R., E. of Lae, 100 m, Sept. 13, 1955 (Gressitt); 1, Wewak, 2–20 m, Oct. 11, 1957 (Gressitt). **West N. G.**: 1, Hollandia, Apr. 1945 (Malkin, U.S.N.M.); 1, same locality, 100 m, Aug. 24, 1955 (Gressitt).

Measured specimens. The ♂ holotype and 1 ♀ paratype from Dobodura.

Notes. This species may be related to the preceding (*papuella*) but has the prothorax more hemispheric, a more distinct elytral cloud, and much heavier dorsal microsculpture. It is somewhat similar also to *Lebia melanota* Chaudoir of Australia and Java (but not New Guinea!) but is much smaller, with more hemispheric prothorax, and with the dark dorsal elytral mark less defined.

Lebia insularum n. sp.

Description. With characters of genus; form (Fig. 41) of typical *Lebia* with rather wide prothorax; bicolored, head and prothorax red, elytra piceous; lower surface red with sides of abdomen piceous; appendages reddish testaceous; shining, reticulate microsculpture absent or faint on front and pronotum, distinct and moderately transverse on elytra. *Head* 0.80 and 0.79 width prothorax; front with trace of large but indistinct (perhaps variable) V-shaped impression. *Prothorax* transverse, not hemispheric; width/length 1.82 and 1.87; sides broadly rounded, slightly sinuate before slightly obtuse, blunted posterior angles; base margined, apex weakly or not margined at middle. *Elytra* slightly narrowed anteriorly; width elytra/prothorax 1.72 and 1.70; apices obliquely weakly sinuate-truncate with outer angles broadly and sutural angles narrowly rounded; striae deep, not distinctly punctulate. *Secondary sexual characters* of ♂ as described for genus; ♂ with 2 setae before apex each side last ventral segment; ♀ unknown. *Measurements*: length *c.* 7.5; width *c.* 3.4 mm.

Types. Holotype ♂ (Bishop Mus.) from Normanby Is., Wakaiuna, Sewa Bay, **Papua**, Jan. 1–8, 1957 (Gressitt); and 1 ♂ paratype (C.S.I.R.O., Canberra, Australia) from Rossel Is., **SE. Papua**, Oct. 1963 (W. W. Brandt).

Notes. Although this distinct species is placed in relation to others in the preceding *Key to Species*, I do not know its real relationships.

Genus *LACHNODERMA* Macleay

Macleay 1873, Trans. Ent. Soc. New South Wales 2, p. 321.
Csiki 1932, Coleop. Cat., Carabidae, Harpalinae 7, p. 1347 (see for additional references and list of species).
Jedlicka 1963, Ent. Abhandlungen 28, p. 302.

Diagnosis. Form (Fig. 42) diagnostic; and see preceding *Key to Genera of Lebiini of New Guinea.*

Description. None required here.

Type species. Lachnoderma cinctum Macleay, of Australia.

Generic distribution. **SE. Asia** including **India** and **Japan**, and across the islands to the **Philippines**, **New Guinea**, and **Australia**.

Notes. I do not know how the different species of this genus are related to each other, and I do not know their habitats and habits.

Lachnoderma foveolatum Sloane

Sloane 1915, Proc. Linnean Soc. New South Wales 40, p. 472.

Description. None required here: the only species of the genus in New Guinea; readily recognized by form (Fig. 42), color (see *Notes* below), very coarse sculpture, and pubescence; wings full; length (to apex of elytra) *c.* 8 mm.

Type. From Cairns District, North Queensland, **Australia**; in Sloane Coll., Canberra (seen).

Occurrence in New Guinea. Only in **Papua**: 1, Yule Is. (Van Emden Coll., British Mus.); 1, Port Moresby, Sept. 24, 1955 (Gressitt), in light trap; 1, Kiunga, Fly R., Aug. 1–3, 1957 (W. W. Brandt, Bishop Mus.); 2, Laloki, 1909, 1910 (F. Muir, H.S.P.A.); 2, Dogura, Oct. 20–Nov. 19, 1955 (E. L. Cassidy, Bishop Mus.); 1, Goilala, Loloipa, Owen Stanley Rge., Jan. 1–15, 1958 (W. W. Brandt, Bishop Mus.).

Notes. Sloane's (Australian) type had the prothorax red and elytra wholly blue-black. Some Papuan specimens are similar but others have the sides of the prothorax blackish and the suture more or less red. The variation is apparently individual.

Genus *SINURUS* Chaudoir

Chaudoir 1869, Ann. Soc. Ent. Belgium 12, p. 129. Jedlicka 1963, Ent. Abhandlungen 28, pp. 298, 368 (with key to the 3 known species).

Diagnosis. Form (Fig. 43) diagnostic; and see preceding *Key to Genera of Lebiini of New Guinea.*

Description. None required here, but note labrum long, emarginate, 6-setose; mentum with short tooth; ligula very wide (or fused with paraglossae), 4-setose; 4th hind-tarsal segments small, simply emarginate; claws with *c.* 4 teeth; ♂ front tarsi with 3 segments each with 2 slender squamae at apex; ♂ ♀ both with 1 seta each side last ventral segment.

Generic distribution. **SE. Asia** (**Burma**, etc.) across the islands to the **Philippines** and **New Guinea**.

Type species. Sinurus opacus Chaudoir (below).

Notes. "*Sinurus*?" *obscurus* Sloane, from Sattelberg, N-E. N.G., is transferred to *Mochtherus* (*q. v.*).

Sinurus somewhat resembles but is apparently *not* related to *Coptoglossus* of Australia.

Sinurus opacus Chaudoir

Chaudoir 1869, Ann. Soc. Ent. Belgium 12, p. 130. Jedlicka 1963, Ent. Abhandlungen 28, p. 368. Louwerens 1964, Ent. Tidskrift 85, p. 188.

Description (selected characters only). With characters of genus; form as in Figure 43; dull black; not setulose (except elytral margins very finely setulose) but entire upper surface heavily, finely, *c.* isodiametrically microreticulate. *Head* 0.75 and 0.72 width prothorax. *Prothorax* variable in shape and proportions; width/length 1.27 and 1.43; base/apex 1.21 and 1.11; sides slightly (variably) angulate near middle. *Elytra*: width elytra/prothorax 1.65 and 1.59; striae entire, well impressed, with long, impressed scutellar striae. *Measurements* (New Guinean specimens): length *c.* 10–11; width *c.* 4.4–5.2 mm.

Type. From **Borneo**; in Oberthür Coll., Paris Mus. (not seen).

Occurrence in New Guinea. **Papua**: 1, Popondetta, 25 m, May 1966 (Shanahan-Lippert, Bishop Mus.), in light trap. **N-E. N. G.**: 1, lower Busu R., Huon Pen., Mar. 28, 1955 (E. O. Wilson, M.C.Z.), in lowland rain forest. **West N. G.**: 1, Araucaria Camp, 800 m, Mar. 1939 (Toxopeus); 1, Mt. Gyifrie, sea level–1000 ft. (–*c.* 300 m), Apr. 1939 (Cheesman, S. Australian Mus. (*sic*)); 3, Waigeu Is., Camp 1, Mt. Nok, 2500 ft. (*c.* 760 m), May 1938 (Cheesman).

Measured specimens. Two (♂ ♀) from Waigeu.

Notes. The known range of *opacus* is from Perak (**Malay Pen.**) and perhaps **Burma** to the **Philippines** and **New Guinea**. The 7 New Guinean specimens vary in shape and proportions of prothorax. I cannot separate them satisfactorily from 1 from Perak and 4 from the Philippines that I have for comparison.

The few specimens of this species that I have collected (in the Philippines) were, I think, among fermenting leaves on the ground in rain forest.

Genus *STENOTELUS* Bouchard

Bouchard 1903, Ann. Soc. Ent. France 72, p. 174. Jedlicka 1963, Ent. Abhandlungen 28, p. 371.

Diagnosis. See Figure 44, and *Key to Genera of Lebiini of New Guinea.*

Description. None required here, but note labrum rather narrow, subtruncate, not or at most faintly emarginate, 6-setose; ligula, 4th hind-tarsal segment, claws, and secondary sexual characters *c.* as described for *Sinurus* (above).

Type species. Stenotelus opacus Bouchard.

Generic distribution. **Malay Pen., Greater Sunda Islands**, and **Philippines** (*opacus*); **Celebes** (*piceus* Louwerens 1952, Treubia 21, p. 217); and now **New Guinea** (new species described below).

Notes. The species of this genus live on tree trunks in rain forest and are probably nocturnal.

Stenotelus spinosus n. sp.

Description. With characters of genus; form as in Figure 44; black, appendages dark; upper surface not pubescent, but elytral margins very finely short-setulose; rather shining, reticulate microsculpture *c.* isodiametric on front, somewhat transverse on disc of pronotum, more transverse on elytra; lower surface with sparse, irregular, short pubescence. *Head* 0.88 and 0.88 width prothorax; front weakly impressed each side anteriorly. *Prothorax* cordate with sides angulate before middle and strongly sinuate posteriorly (but sinuation less than in *opacus*); width/length 1.44 and 1.51; base/apex 1.07 and 1.07; apex margined, base not distinctly so; side margins strongly reflexed, each with a seta at angulation and at (blunted) basal angle; disc with usual middle line and transverse impressions, and faintly transversely strigulose. *Elytra*: width elytra/prothorax 1.67 and 1.72; humeri rounded but prominent; outer-apical angles spined, sutural angles acutely toothed; striae entire, moderately impressed (but scutellar striae faint); 3rd intervals each with 2 conspicuous seta-bearing punctures on inner edge slightly behind middle and near apex. *Inner wings* full. *Legs* slender; 4th hind-tarsal segment long, slender, scarcely emarginate; 5th segment with short, weak accessory setae; claws 4-toothed, the innermost tooth small. *Secondary sexual characters*: ♂ front tarsi scarcely dilated but with 3 segments 2-seriately squamulose (squamae often disarranged); ♂ with 1, ♀ 2 setae each side near apex last ventral segment. *Measurements*: length 7.4–8.5; width 3.1–3.7 mm.

Types. Holotype ♂ (M.C.Z., Type No. 31,402) and 13 paratypes from lower Busu R., Huon Pen., **N-E. N. G.,** May 4, 1955 (E. O. Wilson), in lowland rain forest; and additional paratypes as follows. **Papua**: 5, Dobodura, Mar.–July 1944 (Darlington); 1, Kiunga, Fly R., Aug. 24–27, 1957 (W. W. Brandt, Bishop Mus.); 4, Normanby Is., Wakaiuna Bay, Dec. 1–10, 1956, and Jan. 1–8, 1957 (W. W. Brandt, Bishop Mus.). **West N. G.**: 1, Mt. Nomo, S. of Mt. Bougainville, 700 ft. (*c.* 210 m), Feb. 1936 (Cheesman); 2, Waigeu Is., Camp 1, Mt. Nok, 2500 ft. (*c.* 760 m), May 1938 (Cheesman).

Measured specimens. The ♂ holotype and 1 ♀ paratype from Dobodura.

Notes. S. spinosus is probably related to *S. piceus* Louwerens of Celebes (see under *Generic distribution,* above) but *piceus* is described as pubescent, with outer-apical angles of elytra only strongly toothed, while *spinosus* is not pubescent and has these angles spined, although the length of the spines varies.

The few specimens of this species that I collected were taken on trunks of standing and fallen trees in rain forest, mostly under burlap bands put out to trap nocturnal Carabidae.

Genus *MISCELUS* Klug

Klug 1834, Jahrbüchern Insectenkunde 1, p. 82.
Sloane 1907, Deutsche Ent. Zeitschrift for 1907, p. 473.
——— 1923, Trans. Ent. Soc. London for 1923, p. 250.
Csiki 1932, Coleop. Cat., Carabidae, Harpalinae 7, p. 1359 (see for synonymy and additional references).
Andrewes 1935, Fauna British India, Coleop., Carabidae 2, p. 3.
Jeannel 1942, Faune de France, Coléop. Ca-

rabiques, Part 2, p. 1017 (footnote: included in "Pericalidae").
Jedlicka 1963, Ent. Abhandlungen 28, p. 398.

Diagnosis. Form (Fig. 45) characteristic (note form of eyes and genae, and of elytral apices); 1 or 2 setae over each eye (see *Notes* below); clypeus emarginate; labrum long, strongly rounded at apex, 6-setose, emarginate in some species but not in others; mentum toothed; ligula truncate, with usually 4 setae at apex, and additional setae in 2 irregular rows posteriorly; paraglossae longer than ligula, rounded, without setae; mesosternum wide between coxae; metasternum with longitudinal row of small tubercles each side of middle; wings full; 4th hind-tarsal segments small, oval, weakly emarginate; 5th segments with weak accessory setae; claws not toothed; ♂ front tarsi scarcely dilated but each with 3 segments 2-seriately squamulose below; ♂ with small patch of dense pubescence on lower edge of front femur near base; ♂ with 1, ♀ 2 setae each side last ventral segment, the inner setae in ♀ distant from margin.

Description. None required here.

Type species. Miscelus javanus Klug.

Generic distribution. SE. **Asia** (including **Ceylon** and **India**) to the **Philippines**, **New Guinea**, and part of Cape York, **Australia**.

Notes. The taxonomic position of this remarkable genus is doubtful, but will not be debated here. Sloane (1907) suggested a separate tribe for it, but one of the characters he stressed (the presence of only 1 seta over each eye) is inconstant within the genus (see below), and Sloane later (1923) doubted if tribal separation was valid. Andrewes (1935) did give it tribal rank.

The variation in number of setae over each eye in this genus is remarkable. It has been noticed before, but has not been adequately described. Some of the species, including the type of the genus (*javanus* Klug), have only 1 seta over each eye (Fig. 169), while others have 2 (Fig. 168). Many species of Carabidae belonging to genera that normally have 2 pairs of setae over the eyes are known to have lost the anterior pair, but the posterior setae then usually remain in their original position, between or slightly behind the posterior corners of the eyes. But in the *Miscelus* with a single seta over each eye, the seta is between the positions of the 2 original ones, and appears to correspond to the single seta over each eye of the tribe Harpalini. The New Guinean *Miscelus* with 1 and with 2 setae over each eye are apparently different species, but they are so similar that some authors (not noticing the setae) have failed to separate them or have treated them as "varieties." Intermediates do not usually occur: each individual has either 2 setae over each eye or 1 seta in intermediate position. The only exception I have found is a ♀ *unicolor* from Geelvink Bay (Paris Mus.) with 1 seta each side in intermediate position and also, but only on the left side, an additional seta posteriorly. Most common species of *Miscelus* have 1 seta over each eye, but forms with 2 occur in Ceylon and southeastern Asia as well as in New Guinea. I plan to consider this case in more detail in Part IV of the present work, in discussion of variation of taxonomic characters.

The variation of the labrum, entire or emarginate in different members of this genus, is noteworthy too.

The species of *Miscelus* that I have collected in New Guinea and the Philippines were on or under the bark of tree trunks or logs in rain forest.

KEY TO SPECIES OF *MISCELUS* OF NEW GUINEA

1. Elytral intervals 3, 5, 7 carinate at base; (2 setae over each eye; prothorax more quadrate; length 14.5 mm) (p. 93) *luctuosus*
– Elytral intervals not carinate at base 2
2. Two setae over each eye; labrum with apex emarginate; outer-apical elytral angles more narrowly rounded (p. 93) *sibling*
– One seta over each eye; labrum not emarginate; outer-apical angles of elytra more broadly rounded 3
3. Not spotted (p. 93) ..... *unicolor*
– Elytra with subapical sutural red spot (p. 94) ..... (*javanus*)

Miscelus luctuosus Putzeys

Putzeys 1875, Ann. Mus. Civ. Genoa 7, p. 725.
Andrewes 1935, Fauna British India, Coleop., Carabidae 2, p. 3, footnote.

Description. A large *Miscelus* with relatively square prothorax and with elytral intervals 3, 5, and 7 carinate at base; length 14.5 mm; other distinguishing characters including number of supraocular setae and emargination of labrum not noted by Putzeys, but Andrewes specifies 2 setae over each eye in this species.

Type. From Andai, **Papua**, New Guinea (Beccari and D'Albertis, Genoa Mus.) (not seen).

Occurrence in New Guinea. Apparently known only from the type.

Notes. I have seen no *Miscelus* with carinate elytral intervals from New Guinea, although carinate forms do occur elsewhere. I think the species is probably distinct. It should be easily recognizable.

Miscelus sibling n. sp.

Description. With characters of genus; form (Fig. 45) as usual; black, not spotted. *Head* 0.83 and 0.78 width prothorax; 2 setae over each eye; labrum emarginate at apex. *Prothorax* subcordate; width/length 1.24 and 1.22; base/apex 0.94 and 0.95; basal transverse impression very deep. *Elytra*: width elytra/prothorax 1.33 and 1.28; outer-apical angles narrowly rounded; intervals not carinate at base. *Wings* full. *Secondary sexual characters* as for genus. *Measurements*: length 12.0–14.5; width *c.* 4.1–4.5 mm.

Types. Holotype ♂ (Bishop Mus.) and 4 paratypes (2 in M.C.Z., Type No. 31,403) from Wau, Morobe Dist., **N-E. N. G.**, 1100–1200 m, dates in Sept., Oct., 1961, 1962 (holotype, 1100 m, Oct. 13, 1961) (Sedlaceks); and additional paratypes as follows. **Papua**: 2 (♀ ♀), Dobodura, Mar.–July 1944 (Darlington); 3, Goilala, Loloipa, Owen Stanley Rge., (1 specimen 975 m), Nov. 16–25, 1957 and Jan. 16–30, 1958 (W. W. Brandt, Bishop Mus.). **N-E. N. G.**: 2, Sattelberg, Huon Gulf, 1899 (Biró); 1, same locality (British Mus.); 1, Karimui, 1080 m, July 14–15, 1963, (Sedlacek); 1, Okapa, Aug. 6, 1965 (Hornabrook). **West N. G.**: 1, Tami, May 11, 1903 (Paris Mus.).

Measured specimens. The ♂ holotype and 1 ♀ paratype from Dobodura.

Notes. This and the following species (*unicolor*) are sympatric, occurring at several of the same localities, and both occur also in **New Britain**.

Miscelus unicolor Putzeys

Putzeys 1875, Ann. Mus. Civ. Genoa 7, p. 725.
?*stygicus* Putzeys 1875, Ann. Mus. Civ. Genoa 7, p. 726.
Sloane 1907, Deutsche Ent. Zeitschrift for 1907, p. 474.
?*morioformis* Macleay 1876, Proc. Linnean Soc. New South Wales 1, p. 168.
Sloane 1907, Deutsche Ent. Zeitschrift for 1907, p. 474.

Description. None required here. This insect, whatever its proper name (see discussion below), is the common, smaller, unspotted *Miscelus* of New Guinea, with 1 seta over each eye; labrum not emarginate; outer-apical angles of elytra broadly rounded; length (in New Guinea) 9.5–13.0 mm.

Types. Of *unicolor*, from **Java**, should be in Brussels Mus.; of *stygicus*, from Andai, **Papua**, now in Genoa Mus.; of *morioformis*, from Hall Sound, **Papua**, presumably in Macleay Mus., Sydney (none seen).

Occurrence in New Guinea. Common and widely distributed: 69 specimens, from numerous localities in all three political divisions of **New Guinea**; most at low altitudes, but reaching 1200 m at Wau.

Notes. The application of the name *unicolor* to this species in New Guinea is conventional. Without revising the whole genus, which I cannot do, I cannot decide the relationships of the New Guinean population to populations farther west, nor can I decide the relationship of the unspotted populations to spotted *javanus*.

This species ("*morioformis*") is recorded

from Coen, halfway up the Cape York peninsula, Australia, by Sloane (1907).

(*Miscelus javanus* Klug)

Klug 1834, Jahrbüchern Insectenkunde 1, p. 82, pl. 1, fig. 9.
Csiki 1932, Coleop. Cat., Carabidae, Harpalinae 7, p. 1359 (see for many additional references and conventional synonymy).

Description. None required here. If the typical form of this species occurs in New Guinea, it is the only spotted *Miscelus* there. Length *c.* 8.5–11.0 mm.

Types. From **Java**; now should be in Berlin U. Zool. Mus. (not seen).

Occurrence in New Guinea. Doubtful: New Guinea has sometimes been included in the range of this species, but the synonymy is confused and old published records are doubtful, and I have seen no specimens from the island.

Notes. The supposed unspotted form of *javanus, unicolor* Putzeys, which may or may not really be conspecific, does occur in New Guinea and is treated above.

Genus *HOLCODERUS* Chaudoir

Chaudoir 1869, Ann. Soc. Ent. Belgium 12, p. 153.
Csiki 1932, Coleop. Cat., Carabidae, Harpalinae 7, p. 1360 (see for additional references and list of species).
Jedlicka 1963, Ent. Abhandlungen 28, p. 396.

Diagnosis. Form (of New Guinean species) as in Figure 46 (but form diverse in species outside New Guinea); color metallic; pronotum with 1 or more strong setae at or near each *anterior* angle; elytral apices unarmed but very strongly sinuate-emarginate; length *c.* 8–9 mm.

Description (selected additional characters only). Not pubescent above (sparsely so below). *Head*: labrum moderately long, subtruncate or slightly emarginate, 6-setose; mentum toothed; labium 4-setose, paraglossae distinct, longer than labium, without setae. *Prothorax*: pronotum with middle line coarse. *Elytra*: 3rd intervals with 3 or more punctures, anterior puncture on outer and middle and posterior punctures on inner edge of intervals. *Inner wings* full. *Legs*: 4th hind-tarsal segments scarcely longer than wide, shallowly emarginate; 5th segments with accessory setae; claws with *c.* 4 weak teeth grouped near middle. *Secondary sexual characters*: ♂ front tarsi with 3 segments 2-seriately squamulose (apical squamules of 3rd segment overlapping but not attached to 4th segment); 2 setae each side last ventral segment in both sexes.

Type species. Holcoderus praemorsus Chaudoir, of Ceylon.

Generic distribution. **SE. Asia** (including **Ceylon** and **India**) and across the islands to the **Philippines**, **New Guinea**, and northern **Australia**.

Notes. This genus is relatively diverse in the western part of the Malay Archipelago. A single species group extends eastward to New Guinea and Australia (see *Notes* under following species).

Holcoderus elongatus (Saunders)

Saunders 1863, Trans. Ent. Soc. London (3) 1, p. 466, pl. 18, fig. 5a-b (*Catascopus*).
Wallace 1863, in Saunders paper cited above, p. 460 (*Catascopus*).
Csiki 1932, Coleop. Cat., Carabidae, Harpalinae 7, p. 1360 (see for additional references).
Andrewes 1946, Proc. R. Ent. Soc. London (B) 15, p. 87.

Description. None required here. See Figure 46, characters stated under genus, the following *Notes*, and Andrewes' (1946) detailed redescription. Length *c.* 8–9 mm.

Type. From Dorey, **West N. G.**, collected by Wallace; type in Berlin U. Zool. Mus. (not seen).

Occurrence in New Guinea. Probably throughout **New Guinea**: 24 specimens, from all 3 political divisions of the island; most from low altitudes (including Dobodura), but 2 from Wau, 1150, 1200 m, and 1 from Waigeu Is., 2500 ft. (*c.* 760 m).

Notes. The variability of this species (if it is all one species) is remarkable. The form is relatively constant, but color varies from wholly blue or green or coppery to bicolored with blue or green elytra and

bright copper or violet prothorax. The punctation of the pronotal disc varies: the disc is always closely punctate in part, but a variable area centered near or behind the middle is usually less punctate. And the lateral prothoracic setae vary in number and position: at least 1 strong seta is always present (unless broken off) at each posterior angle, at the angulation of the prothoracic margin near or just before the middle on each side, and at each anterior angle, but some individuals have additional lateral setae of different sizes between the anterior and median setae, and the occurrence of these extra setae is sometimes strikingly unsymmetric.

This variation makes exact definition of the species and comparison with other species difficult. I think, however, that all New Guinean specimens of the genus can be referred to *elongatus*, that the latter is probably confined to New Guinea and adjacent small islands, and that closely related forms occur both in the western Malay Archipelago (e.g., *gracilis* Oberthür) and in tropical northeastern Australia (*coeruleipennis* Sloane).

I do not know the habits of *Holcoderus* but I suspect that *elongatus* may inhabit tree tops. This would account for my failure to find the species' natural habitat. My single specimen from Dobodura was taken at light, but this seems to be exceptional. No other specimens are labeled as from light traps, and the bright color suggests partly diurnal habits. However, Wallace (1863) says that *elongatus* flies at dusk.

Genus *MINUTHODES* Andrewes

Andrewes 1941, Ann. Mag. Nat. Hist. (11) 7, p. 317.
Platia Chaudoir 1869, Ann. Soc. Ent. Belgium 12, p. 155 (not *Platia* Hübner 1820, *et al.*).
Csiki 1932, Coleop. Cat., Carabidae, Harpalinae 7, p. 1361.
Andrewes 1939, Ann. Mag. Nat. Hist. (11) 3, p. 137.

Diagnosis. Usually immediately recognizable by form (head very wide but eyes smaller than usual in tribe, prothorax usually *c.* 2× wider than long, and elytra short and subquadrate), small size (4–6.5 mm), and other characters given in the *Key to Genera of Lebiini.*

Description. Form as indicated above and in Figures 47–58; upper surface especially of elytra often (not always) with short pubescence, and elytra often (not always) with color patterns of many pale lines or pale blotches. *Head* wide but with relatively small eyes; antennae rather short; 2 setae over each eye; front slightly impressed each side anteriorly; clypeus subtruncate, with 1 seta each side; labrum rather long, irregularly rounded or subtruncate anteriorly, 6-setose; mentum toothed; ligula with 2 principal setae and 1 or more much smaller setae; paraglossae attached to ligula, longer, broadly rounded, without setae. *Prothorax* very wide, scarcely lobed at base, very broadly emarginate anteriorly, with wide, depressed or slightly reflexed lateral margins; each margin with a seta at basal angle and at or before middle of length; disc with usual middle line, weak anterior transverse impression, deeper subbasal transverse impression. *Elytra* very wide and short; humeri prominent but rounded; apices obliquely sinuate-truncate; striae entire; 3rd interval with 3 dorsal punctures at least in some species, but these punctures often difficult to distinguish amid other punctation and pubescence. *Inner wings* full. *Lower surface* not or not extensively pubescent. *Legs* rather slender; tarsi sparsely setose above; 4th hind-tarsal segment weakly emarginate; 5th segment with accessory setae; claws each with *c.* 3 short, weak (vestigial?) teeth. *Secondary sexual characters*: ♂ front tarsi slightly dilated, with numerous narrow squamae not arranged in 2 series; 2 setae each side near apex last ventral segment in both sexes; and see under *M. sexualis* for special secondary sexual characters of this species.

Type species. Platia lineella Chaudoir,

fixed by Andrewes 1939, p. 137. Andrewes designated this species as the type of *Platia* Chaudoir, and it is therefore also the type of *Minuthodes*, proposed as a new name for preoccupied *Platia*.

Generic distribution. Nine species on **New Guinea** and neighboring small islands, fewer on the **Moluccas**, **Celebes**, **New Britain**, and northern **Australia**; none known elsewhere.

Notes. This is a very distinct genus, confined to a limited geographic area (above). The insects live wholly or chiefly on tree trunks and fallen logs in rain forest. Although they are winged, they do not often fly to light, which suggests that they are mainly diurnal.

The striking secondary sexual characters of the ♀ of *sexualis* (and of the related *brachydera* Chaudoir of the Moluccas) are unique, so far as I know.

The Greek ending *-odes* does not indicate gender, and Andrewes did not specify gender when he proposed *Minuthodes* to replace *Platia*. I therefore tentatively treat the name as feminine, to make the gender consistent with *Platia*.

KEY TO SPECIES OF *MINUTHODES* OF NEW GUINEA

1. Elytra marked with numerous longitudinal pale lines, sometimes much interrupted 2
– Elytra differently marked or not marked 5
2. Median-lateral prothoracic setae before middle, *c.* 1/3 of prothoracic length from apex (p. 96) ..... *papuana*
– Median-lateral setae near middle of prothoracic length 3
3. Elytra dull; (length *c.* 6.5 mm) (p. 97) ..... *rossi*
– Elytra shining (under pubescence) 4
4. Smaller (*c.* 4.8 mm) (p. 97) ..... *sedlaceckorum*
– Larger (*c.* 6.2 mm) (p. 97) ..... *subnitens*
5. Metallic blue black (p. 98) ..... *metallica*
– Not metallic, black with or without reddish yellow spots 6
6. Elytra not plainly pubescent (pubescence actually present but very short, scarcely visible); ♀ last ventral segment usually with square excision at apex, and ♀ hind femur with flange or tooth near apex anteriorly; (shining black, unspotted or 2- or 4-spotted, but if spotted at least 1 pair of spots elongate) ..... *sexualis*
6a. Elytra not spotted, or each with a single pale dash *behind middle* (Fig. 55) (Papua) (p. 98) ..... *sexualis s. s.*
6b. Elytra *either* each with a single *basal* dash, *or* 4-spotted with posterior spots elongate (Figs. 56, A) (central and western New Guinea) (p. 99) ..... subsp. *signata*
– Elytra plainly pubescent; ♀ not as described 7
7. Black, not spotted; (Goodenough Is.) (p. 99) ..... *simplex*
– Each elytron with 2 rather large red spots; (mainland of New Guinea) 8
8. Smaller (4.0–5.3 mm); elytral spots *c.* regular in outline (Fig. 57) (p. 100) .. *regularis*
– Larger (5.5–5.8 mm); elytral spots irregular in outline (Fig. 58) (p. 100) .... *irregularis*

Minuthodes papuana (Sloane)

Sloane 1917, Proc. Linnean Soc. New South Wales 42, p. 433 (*Platia*).

Agonochila lineella Sloane 1907, Deutsche Ent. Zeitschrift for 1907, p. 182 (not *Platia lineella* Chaudoir 1869).

Description. With characters of genus; form as in Figure 48; black or brownish black, appendages irregularly brown, elytra with complex, variable pattern of pale lines (Figs. 48, A); head and pronotum moderately shining although closely punctate, elytra roughened and duller, and upper surface especially elytra with short but distinct pubescence. *Head* 0.78, 0.79, 0.81, and 0.80 width prothorax. *Prothorax*: width/length 2.00, 2.04, 2.00, and 1.96; base/apex 1.04, 1.06, 1.05, and 1.04; median-lateral setae *c.* 1/3 prothoracic length before apex. *Elytra*: width elytra/prothorax 1.46, 1.47, 1.45, and 1.44; outer-apical angles moderately and sutural angles more narrowly rounded. *Secondary sexual characters* as for genus; ♀ last ventral segment and hind femora not modified. *Measurements*: length 4.4–5.2; width 2.2–2.6 mm.

Type. From Herbertshöhe, "New Pomerania" (= **New Britain**); should be in Deutsches Ent. Institut, Berlin (not seen).

Occurrence in New Guinea. Common and widely distributed at low altitudes throughout **New Guinea**, and occurring also on Normanby, Goodenough, and Ros-

sel Is.: 142 specimens seen in all; reaches at least 1200 m at Wau.

Measured specimens. A ♂ ♀ from Dobodura and ♂ ♀ from Normanby Is., figures listed in this order.

Notes. This species occurs on **New Britain** as well as New Guinea, and it apparently represents a group of species (or subspecies?) that includes *lineella* (Chaudoir) of the Moluccas (I have a series from Morotai Is.) and *queenslandica* (Sloane) of North Queensland, Australia (I have specimens from near Cairns and from the Rocky Scrub, Cape York Pen.). The different forms of this group are distinguished mainly by elytral color pattern: *lineella* has a relatively simple pattern of 3 pale lines on each elytron (Fig. 49); *queenslandica*, a complex pattern of short lines, with 1 or 2 longer lines formed by fusion of short ones (Fig. 50); and *papuana*, a *c.* intermediate but very variable pattern (Figs. 48, A). Some specimens from New Guinea have elytral markings like those of the type (from New Britain) as described by Sloane.

The elytral pattern of *papuana* may be genetically dimorphic at some localities (cf. the dimorphism of markings described for *sexualis*), but the variation as a whole is so complex that I have been unable to analyze it satisfactorily.

Minuthodes rossi n. sp.

Description. With characters of genus; form as in Figure 51; brownish piceous, elytra with pattern of many short narrow longitudinal pale lines in 3 transverse series; head and prothorax moderately shining although closely punctate, elytra roughened and duller, and upper surface especially elytra with short pubescence. *Head* 0.71 width prothorax, narrower than usual in genus. *Prothorax*: width/length 1.79; base/apex 1.21; sides irregularly broadly rounded, almost subangulate at middle, slightly sinuate before well defined but slightly obtuse basal angles; median-lateral setae near middle of prothoracic length. *Elytra*: width elytra/prothorax 1.37; outer-apical angles broadly rounded, apices subangulate *c.* opposite ends 2nd intervals, sutural angles narrowly rounded. *Secondary sexual characters* of ♂ as for genus; ♀ unknown. *Measurements*: length 6.5; width 3.2 mm.

Type. Holotype ♂ (California Acad.) from Maffin Bay, **West N. G.,** Sept. 1944 (E. S. Ross); the type is unique.

Notes. This seems to be a distinct species although known from a single specimen from a well collected lowland locality.

Minuthodes sedlacekorum n. sp.

Description. With characters of genus; form as in Figure 52; irregular reddish piceous with complex elytral pattern of many short longitudinal pale lines in 3 irregular transverse series, appendages irregular testaceous and brown; upper surface including elytra shining although pubescent and moderately closely punctate. *Head* 0.74 width prothorax. *Prothorax*: width/length 1.78; base/apex 1.23; sides broadly arcuate, slightly sinuate before well defined posterior angles; median-lateral setae near middle of prothoracic length. *Elytra*: width elytra/prothorax 1.49; outer-apical angles broadly rounded, sutural angles narrowly rounded; striae coarsely but irregularly punctate, intervals more finely punctate. *Secondary sexual characters* of ♂ as described for genus; ♀ unknown. *Measurements*: length 4.6–4.8; width 2.3 mm.

Type. Holotype ♂ (Bishop Mus.) from Wau, Morobe Dist., **N-E. N. G.,** 1050 m, Sept. 16, 1961 (Sedlaceks); 1 ♂ paratype (M.C.Z., Type No. 31,588), Pindiu, Huon Pen., **N-E. N. G.,** 870–1300 m, Apr. 21–22, 1963 (Straatman).

Notes. More material may show that this is a (distinct) geographic representative of the preceding species, *rossi.*

Minuthodes subnitens n. sp.

Description. With characters of genus; black, elytra with pattern (Fig. 53) of many short longitudinal pale lines in 3

irregular transverse series, appendages reddish testaceous; rather shining although whole upper surface rather closely punctate and short-pubescent. *Head* 0.74 width prothorax; as usual in genus except labrum broadly emarginate at apex (an individual rather than specific character?). *Prothorax*: width/length 1.84; base/apex 1.25; base more lobed than usual; sides broadly arcuate, sinuate before *c.* right posterior angles, with median-lateral setae near middle of length. *Elytra*: width elytra/prothorax 1.44; outer-apical angles broadly and sutural angles more narrowly rounded; striae impressed but not more coarsely punctate than intervals. *Secondary sexual characters* of ♂ as for genus; ♀ unknown. *Measurements*: length 6.2; width 2.8 mm.

Type. Holotype ♂ (British Mus.) from Mt. Baduri, Japen Is., **West N. G.,** 1000 ft. (305 m), Aug. 1938 (Cheesman); the type is unique.

Notes. This may (or may not) be a (distinct) geographic representative of the 2 preceding species, *rossi* and *sedlacekorum.*

Minuthodes metallica n. sp.

Description. With characters of genus; form as in Figure 47; black, elytra with strong blue-purple reflections, appendages dark brown; shining but short-pubescent, head and disc of pronotum sparsely punctulate, elytra rather closely punctate as well as punctulate. *Head* 0.79 width prothorax. *Prothorax*: width/length 1.98; base apex 1.15; sides rather strongly rounded anteriorly, nearly straight and converging posteriorly until abruptly sinuate just before *c.* right posterior angles; median-lateral setae *c.* ⅓ of prothoracic length from apex. *Elytra*: width elytra/prothorax 1.41; outer-apical angles broadly and sutural angles more narrowly rounded; striae obsolete. *Secondary sexual characters* of ♂ as for genus; ♀ unknown. *Measurements*: length 5.0; width 2.6 mm.

Type. Holotype ♂ (British Mus.) from Kokoda, **Papua**, 1300 ft. (*c.* 400 m), Sept. 1933 (Cheesman); 1 ♀ paratype (S. Australian Mus.), Mt. Lamington, **Papua**, 1300–1500 ft. (*c.* 400–460 m) (McNamara).

Notes. This is the only metallic *Minuthodes* known from New Guinea.

Minuthodes sexualis n. sp.

Description. With characters of genus; form as in Figure 55; black or brownish black, appendages dark, elytra *either* without markings *or* each with 1 pale dash on 5th interval behind middle; shining, pubescence of most of upper surface absent or so short as scarcely to be visible. *Head* 0.88 and 0.86 width prothorax; front sparsely punctulate. *Prothorax* wide but with relatively narrow base; width/length 2.03 and 2.03; base/apex 0.98 and 1.00; median-lateral setae *c.* ⅓ of prothoracic length from apex; disc sparsely punctulate. *Elytra*: width elytra/prothorax 1.35 and 1.34; outer-apical angles broadly rounded, sutural angles blunted or subdenticulate (slightly variable); striae impressed and punctate; intervals convex, without distinct reticulate microsculpture, sparsely irregularly punctate or punctulate. *Secondary sexual characters*: ♂ as for genus; ♀ usually with last ventral segment with conspicuous *c.* square excision at apex, and ♀ always with a short ridge or blunt tooth on anterior edge hind femur near apex. *Measurements*: length 4.5–5.6; width 2.0–2.5 mm.

Types. Holotype ♀ (M.C.Z., Type No. 31,404) and 1 ♀ paratype from Dobodura, **Papua**, Mar.–July 1944 (Darlington); and additional paratypes as follows, all from **Papua**: 7, Oro Bay near Dobodura, Dec. 1943–Jan. 1944 (Darlington); 2, Kokoda-Pitoki, 450 m, Mar. 24, 1956 (Gressitt); 1, Mafulu, 4000 ft. (1220 m), Dec. 1933 (Cheesman); 1, "Daradae Pl'n," 80 km N. Port Moresby, 500 m, Sept. 6, 1959 (T. C. Maa, Bishop Mus.); 1, Koitakinumu, Apr. 1, 1918 (J. T. Zimmer, Chicago Mus.); 10, Mt. Lamington, 1300–1500 ft. (*c.* 400–460 m) (McNamara, S. Australian Mus.).

Measured specimens. A ♀ paratype from Kokoda-Pitoki and the ♀ holotype.

Notes. This species is evidently closely related to *M. brachydera* Chaudoir of the Moluccas (described from Batjan Is. and represented by a series from Morotai Is. in the M.C.Z.), but *sexualis* lacks the metallic tone of the elytra of *brachydera*, and the ridge or tooth of the ♀ femur, not quite apical in *sexualis*, is fully apical in *brachydera*. These 2 forms, with the "subspecies" described below, may eventually be considered conspecific, but I prefer to treat the New Guinean populations as a separate species until their interrelationships are better understood.

The material before me suggests that *sexualis* may be dimorphic in two ways. The pale dash on the elytron is either present or absent but never partially developed in all specimens seen, and is sometimes present or absent in different individuals from single localities, for example in those from Oro Bay. And, although most females have a square excision on the last ventral segment as described, 1 of 2 females from Dobodura has the last ventral segment only acutely emarginate.

Minuthodes sexualis signata n. subsp.

Description. As typical *sexualis* (above) except for markings (Figs. 56, A): elytra each with a broad posthumeral spot and usually also a narrow stripe behind middle (chiefly on 5th interval but bent inward posteriorly) reddish or yellow (some individuals from Wau have only the posthumeral stripe, as noted below). *Head* 0.89 and 0.90 width prothorax. *Prothorax*: width/length 1.96 and 2.02; base/apex 1.03 and 1.02. *Elytra*: width elytra/prothorax 1.41 and 1.42. *Secondary sexual characters* as in typical *sexualis*. *Measurements*: length 4.3–5.8; width 2.0–2.9 mm.

Types. Holotype ♀ (M.C.Z., Type No. 31,405) and 3 paratypes from Sambeang, Mongi Watershed, Huon Pen., **N-E. N. G.**, 400 m, Apr. 21, 1955 (E. O. Wilson); and additional paratypes as follows, all from **N-E. N. G.**: 1, Butala, Mongi R., Huon Pen., Apr. 22, 1955 (Wilson, M.C.Z.); 2, lower Busu R., Huon Pen., Apr. 22 and May 12, 1955 (Wilson, M.C.Z.), in lowland rain forest; 2, Finschhafen, Apr. 17 and May —, 1944 (E. S. Ross, California Acad.); 1, Wantoat, Finisterre Rge., 4000 ft. (1220 m), Sept. 9, 1957 (Munroe & Holland, Canadian National Coll.); 1, Lae, 10 m, July 5, 1962 (Sedlacek); 9, Wareo, Finschhafen (L. Wagner, S. Australian Mus.); 16, Simbang, Huon Gulf, 1898 (Biró).

Additional material. **N-E. N. G.**: 11, Wau, Morobe Dist., altitudes from 1050 to 1200 m, dates in Jan., Mar., Aug., Sept., Oct., 1961–1963 (Sedlaceks). **West N. G.**: 42, from localities scattered from Hollandia to the Vogelkop.

Measured specimens. A ♂ paratype from Finschhafen and the ♀ holotype.

Notes. Because this species varies geographically, I have restricted the type series to specimens from a few localities in a comparatively small area.

The elytral markings are essentially constant, with only minor variation, in all specimens except those from Wau, of which only 4 have typical markings, while 7 have markings reduced to a single posthumeral dash on each elytron (Fig. 56 A). I have seen no intermediates between these two patterns. Inheritance of marking in this case, as in typical *sexualis*, may be simply Mendelian.

Minuthodes simplex n. sp.

Description. With characters of genus; form as in Figure 54; black, not marked, appendages brown; surface shining but short-pubescent, head and prothorax punctulate, elytra more closely punctate. *Head* 0.79 width prothorax. *Prothorax*: width/length 2.0; base/apex 1.15; sides irregularly rounded anteriorly, nearly straight and converging posteriorly, abruptly sinuate just before *c.* right posterior angles; median-lateral setae *c.* ⅓ of prothoracic length from apex. *Elytra*: width elytra/prothorax 1.45; outer-apical angles broadly rounded, apices bluntly subangulate opposite ends 2nd intervals, sutural angles narrowly rounded;

striae impressed, not well defined, not specially punctate. *Secondary sexual characters* of ♂ unknown; of ♀ normal, without special characters of *sexualis*. *Measurements*: length 4.7; width 2.4 mm.

Type. Holotype ♀ (Manson Valentine Coll.) from Goodenough Is., **Papua**, Oct. 14, 1943 (W. B. Jones); the type is unique.

Notes. I do not know whether this insular species is represented on New Guinea proper.

Minuthodes regularis n. sp.

Description. With characters of genus; black or brownish black, appendages brownish testaceous, elytra each with *c.* regular posthumeral and subapical spots reddish yellow (Fig. 57); rather shining although surface pubescent and head and pronotum irregularly punctulate or punctate and elytra more closely punctate. *Head* 0.81 and 0.79 width prothorax. *Prothorax*: width/length 1.96 and 1.96; base/apex 1.13 and 1.18; sides rounded anteriorly, *c.* straight and converging posteriorly, briefly but often abruptly sinuate before *c.* right or slightly blunted posterior angles; median-lateral setae *c.* ⅓ of prothoracic length from apex. *Elytra*: width elytra/prothorax 1.46 and 1.44; outer-apical angles broadly and sutural angles narrowly rounded; striae impressed but not sharply limited and not more coarsely punctate than intervals. *Secondary sexual characters* as for genus. *Measurements*: length 4.0–5.3; width 2.1–2.8 mm.

Types. Holotype ♂ (M.C.Z., Type No. 31,406) and 3 paratypes from Dobodura, **Papua**, Mar.–July 1944 (Darlington); and additional paratypes as follows. **Papua**: 1, Fly R. 5 miles below Palmer R., May 23–31, 1936 (Archbold Exp., A.M.N.H.). **N-E. N. G.**: 1, Saidor, Gabumi Village, Finisterre Rge., July 1–21, 1958 (W. W. Brandt, Bishop Mus.); 2, Wau, Morobe Dist., 1150, 1200 m, Sept. 7, 1961, Sept. 26–27, 1964 (Sedlaceks); 1, Swart Vy., Karubaka, 1500 m, Sept. 20, 1958 (Gressitt), in light trap; 1, Wewak, 2–20 m, Oct. 11, 1957 (Gressitt). **West N. G.**: 1, vic. Hollandia, July–Sept. 1944 (Darlington); 1, same locality, 60 m, Nov. 26, 1954 (L. D. Brongersma, Leiden Mus.); 1, Maffin Bay, Aug. 1944 (E. S. Ross, California Acad.); 1, Sibil, Star Rge., 1260 m, Aug. 24, 1959 (Leiden Mus.); 1, mountain slope above Bernhard Camp, 100 m, Apr. 1939 (Toxopeus).

Measured specimens. The ♂ holotype and 1 ♀ paratype from Dobodura.

Notes. *M. regularis* is apparently widely distributed in New Guinea at moderate altitudes.

Minuthodes irregularis n. sp.

Description. With characters of genus; black, elytra each with 2 (posthumeral and subapical) irregular reddish yellow spots (Fig. 58), antennae and palpi reddish testaceous, legs much darker; rather shining although surface short-pubescent, head punctulate at middle and strigose at sides, pronotal disc ± punctulate, elytra more closely punctate and in part faintly microreticulate. *Head* 0.75 and 0.77 width prothorax, as described for genus except strigose at sides and with labrum distinctly emarginate (both specimens). *Prothorax*: width/length 1.97 and 1.86; base/apex 1.12 and 1.11; sides broadly rounded, converging posteriorly, briefly sinuate before *c.* right posterior angles; median-lateral setae *c.* ⅓ (or slightly more) of prothoracic length from apex. *Elytra*: width elytra/prothorax 1.34 and 1.42; outer-apical angles broadly and sutural angles narrowly rounded; striae impressed but not sharply limited and not more coarsely punctate than intervals. *Secondary sexual characters* of ♂ normal; ♀ unknown. *Measurements*: length 5.5–5.8; width 2.8–2.9 mm.

Types. Holotype ♂ (U.S.N.M.) and 1 ♂ paratype (M.C.Z., Type No. 31,407) both from Hollandia, **West N. G.**, May 1945 (B. Malkin).

Notes. This and the preceding species (*regularis*) are superficially similar, but the two are sympatric and differ in sig-

nificant details, and they may not be closely related.

Genus *CATASCOPUS* Kirby

Kirby 1825, Trans. Linnean Soc. London 14, p. 94.
Wallace 1863, *in* Saunders, Trans. Ent. Soc. London (3) 1, pp. 460–461 (habits).
Csiki 1932, Coleop. Cat., Carabidae, Harpalinae 7, p. 1362 (see for additional references).
Andrewes 1937, Proc. R. Ent. Soc. London (B) 6, pp. 187 ff. (key to species of India, etc.).
Jeannel 1949, Coléop. Carabiques de la Région Malgache, Part 2, p. 1007 (in text).
Jedlicka 1963, Ent. Abhandlungen 28, p. 397.

Diagnosis. See *Key to Genera of Lebiini of New Guinea.* In practice most *Catascopus* can be recognized by their medium to large size (in the tribe), form (with prominent eyes, etc.), and usually metallic coloration, without geometric elytral markings.

Description (characters common to New Guinean species of the genus, with exceptions noted). Form variable (Figs. 59–64), slender and convex to broad and depressed; color metallic (except in *brunneus*), usually green, sometimes partly or wholly blue or purple; size *c.* 8–22 mm; upper surface not pubescent, more or less shining (elytra sometimes dull), with microsculpture present or absent, if present *c.* isodiametric on head, somewhat transverse on pronotum and elytra. *Head* with prominent eyes; 2 setae over each eye; front longitudinally impressed each side; clypeus ± emarginate, 1-setose each side; labrum long, rounded at apex, emarginate at apex, 6-setose; antennae with 4 segments glabrous except for tactile setae and a little pubescence at apex 4th segment; mentum toothed; ligula 4-setose, paraglossae much longer, not setose; palpi slender. *Prothorax* quadrate or subcordate; base not lobed; lateral margins variable, each with 1 seta at base and 1 or more near or before middle; base with entire margin (except in *dobodura*), apex at middle not margined or weakly so; disc with impressed middle line, deep posterior transverse impression, and usually weak (but variable) anterior transverse impression. *Elytra* with humeri prominent but rounded (humeral margins slightly thickened in *laevigatus*); apices variable, as described for separate species, often toothed or spined; striae entire, punctation variable; 7th intervals usually and 5th sometimes raised or carinate at base; 3rd intervals usually 3-punctate (2-punctate in *latus*), with punctures often near middle of intervals (not on edges) but position variable. *Inner wings* full. *Lower surface* with some inconspicuous, short, sparse pubescence (much more pubescence along midline in *wallacei* group); last ventral segment usually slightly, broadly (variably) emarginate in both sexes. *Legs* slender; 4th hind-tarsal segments small, weakly emarginate; 5th segments with accessory setae; claws not toothed. *Secondary sexual characters*: ♂ front tarsi slightly (scarcely) dilated, with 3 segments 2-seriately squamulose below; ♂ with 1, ♀ 2 or 3 setae each side last ventral segment (except ♂ as well as ♀ with 2 or 3 setae each side in *strigicollis*).

Type species. C. hardwickei Kirby, of India.

Generic distribution. Represented in 3 separate tropical areas: numerous in tropical **Asia** and the **Malay Archipelago** (and a few in tropical **Australia**); fewer in tropical **Africa** (absent in Madagascar); and probably represented also in tropical **South** and **Central America** (but Jeannel doubts whether the American species should be included in the genus).

Notes. Although *Catascopus* occurs also in Africa and probably in tropical America, its headquarters are in tropical Asia and the Malay Archipelago. The greatest numbers of species are on the Malay Pen. and the western part of the Archipelago, but the genus is well represented east to New Guinea, where 14 species are now known. Of these 14 species, *elegans* and *smaragdulus* range from the mainland of Asia across the islands to northern Australia; *facialis*, from Asia to western New Guinea but not Australia; and *laevigatus* is common to the

Moluccas and New Guinea. Most other New Guinean species of the genus are endemic, and one group of striking species (the *wallacei* group) has probably evolved on New Guinea and is now represented there by at least 5 species. Only 5 *Catascopus* (2 of them endemic) occur in Australia, and they seem to represent 5 separate invasions from New Guinea. So, the distribution of the genus suggests multiple dispersal eastward across the Malay Archipelago, with considerable speciation and some secondary radiation on New Guinea, and minor invasions of northern Australia.

All the *Catascopus* that I know live on tree trunks and fallen logs in rain forest. They are all winged, and very active. Concerning their habits, Wallace (1863) says,

> "The species of the genus *Catascopus* are seminocturnal in their habits, never flying except at night. The species taken at Dorey (viz., *Wallacei*, W. W. S.; *elongatus*, W. W. S. [= *Holcoderus*]; *Aruensis*, W. W. S.; *amoenus*, Chaud. [= *elegans*]) flew against me at dusk. The greater part of the species and individuals I have taken have, however, been captured under the decaying bark of fallen trees.
>
> "As soon as the bark of a tree splits and cracks so as to separate it from the wood, the *Catascopi* frequent it, but I could scarcely ever capture them in that position, owing to their great activity and the force required to tear off the bark. After a tree has lain about a year the bark becomes rotten and can be easily broken off, and then, by the assistance of a net, the insects which lurk beneath it can be more easily captured. The larger species found in Malacca, Borneo and Singapore used frequently to be seen coursing along the surface of some immense fallen trees, from one crack to another, their brilliant bodies glittering splendidly in the sunlight.
>
> "To capture them was by no means easy, as they would get under the trunk where it touched the ground, if closely pursued and no friendly crevice was at hand. Many an hour have I pleasantly spent in hunting them in the dense swampy forests of Borneo. In Malacca and Singapore the spice of fear and danger would be added to the interest of the sport, owing to the probable vicinity of tigers, who might at any moment be watching us as eagerly and with as deadly a purpose as we were watching the poor *Catascopi*.
>
> "However closely pursued I have never seen one of these insects fly in the day time, neither do they come out at all into the light, except to visit some part of the trunk they reside in, to which the subcortical passages do not extend. . . . The species and individuals of this genus are much more abundant in Malacca and Borneo than in the equally luxuriant forests of the Molucas and New Guinea."

Key to Species of *Catascopus* of New Guinea

1. Elytral apices without acute teeth or spines at or near sutural angles 2
– Elytral apices acutely toothed or spined at or near sutural angles 4
2. Outer elytral angles rounded or very obtusely angulate 3
– Outer elytral angles right or (if obtuse) very well defined, sometimes denticulate; length *c.* 10.5–13.5 mm (p. 103) ..... *facialis*
3. Color metallic green or blue; length *c.* 8.5–10 mm (p. 103) ..... *elegans*
– Color brown or bronze; length *c.* 12–13 mm (see also *Notes* under this species) (p. 104) ..... *brunneus*
4. Prothorax with 2 or more lateral setae near or before middle on each side (if setae broken off, positions shown by punctures); form relatively broad and depressed 5
– Prothorax with only 1 median-lateral seta each side; form variable but often more slender and convex 7
5. Two or 3 setae near or before middle each side; length 17.5 mm (see also *Description*) (p. 104) ..... *latus*
– More (often 6) such setae each side 6
6. Elytral striae lightly impressed; elytral margins wider than usual near middle; length *c.* 10–11 mm (p. 104) ..... *laevigatus*
– Elytral striae deeper; elytral margins less wide; length *c.* 12–13 mm (see also *Description*) (p. 105) ..... *sidus*
7. Outer elytral angles blunt or angulate but not spined; relatively small species, usually under 11 mm 8
– Outer elytral angles spined; larger species, 13–21 mm (*wallacei* group) 10
8. Outer elytral angles rounded or obtuse; smaller, *c.* 7.5–8.0 mm (p. 105) ..... *smaragdulus*
– Outer elytral angles usually *c.* right or acute, *or* if obtuse, size larger 9
9. Prothoracic margins narrow (almost as in *elegans*); basal marginal line of pronotum *c.* obsolete; reticulate microsculpture obsolete on disc of elytra; length *c.* 9–10 mm (p. 106) ..... *dohodura*
– Prothoracic margins slightly wider; basal marginal line of prothorax impressed;

reticulate microsculpture distinct on disc of elytra; length 8.7–9.3 mm (p. 106) ... *biroi*

10. Prothoracic margins moderate 11
– Prothoracic margins wider (see *Descriptions*) 13
11. Fifth elytral intervals not or not much raised near base; length *c.* 13–15.5 mm (p. 107) ..... *aruensis*
– Fifth as well as 7th elytral intervals raised near base; usually larger 12
12. Prothorax more quadrate with blunter posterior angles; head and prothorax ± green, elytra blue-purple (note head colored as prothorax); length *c.* 15–18 mm (p. 108) ..... *strigicollis*
– Prothorax more cordate, with more acute posterior angles; prothorax green or cupreous, head and elytra blue-purple (note head colored as elytra); length *c.* 15–20 mm (p. 108) ..... *wallacei*
13. Prothorax narrower (width/length *c.* 1.40); head less depressed posteriorly; head dark, pronotum green cupreous, elytra blue-purple or blue-green; length *c.* 17–22 mm (p. 109) ..... *taylori*
– Prothorax wider (width/length *c.* 1.70); head more depressed posteriorly; head as well as prothorax green, elytra blue-green; length *c.* 20 mm (p. 109) ..... *rex*

Catascopus facialis (Wiedemann)

Wiedemann 1819, Zoologisches Magazin 1, 3, p. 165 (*Carabus*).

Csiki 1932, Coleop. Cat., Carabidae, Harpalinae 7, p. 1364 (see for synonymy, "varieties," and many additional references *not* concerned with New Guinea).

Jedlicka 1963, Ent. Abhandlungen 28, pp. 382, 395 ("*fascialis*").

Description (for recognition only). With characters of genus; form rather compact; green or blue and green; elytra with outer-apical angles well defined, apices sometimes subangulate (variable) near suture, striae deeply impressed and strongly punctate, and 5th and 7th intervals raised; length (in New Guinea) *c.* 10.5–13.5 mm.

Type(s). From "**Bengalia**," in Copenhagen Univ. Mus. (not seen).

Occurrence in New Guinea. **West N. G.**: 1, Maffin Bay, Aug. 1944 (Darlington); 1, "Dorey" (Paris Mus.). Also 1 specimen labeled only "N. guin" (British Mus.).

Notes. If my identifications are correct, this species ranges from **SE. Asia** to the **Philippines**, **Moluccas**, and (western) **New Guinea** but does not reach Australia. It is variable, and its full synonymy and subspecies (if any) remain to be worked out. It is rare in New Guinea and may be confined to the western part of the island (perhaps it has recently arrived from the west). I found it common on Morotai Is. in the Moluccas.

Catascopus elegans (Weber)

Weber 1801, Observations Entomologicae, p. 45 (*Elaphrus*).

Csiki 1932, Coleop. Cat., Carabidae, Harpalinae 7, p. 1363 (see for additional references and extensive synonymy).

Andrewes 1937, Proc. Ent. Soc. London for 1937 (B) 6, p. 189.

Van Emden 1937, Stettiner Ent. Zeitschrift 98, p. 35 (as subsp. *australasiae* Hope).

Jedlicka 1963, Ent. Abhandlungen 28, pp. 380, 385.

amoenus Chaudoir 1861, Berliner Ent. Zeitschrift 5, p. 120.

obliquatus Fairmaire 1881, Le Naturaliste 3, p. 381 (new synonymy).

Description (for recognition only). With characters of genus; form convex; green or partly coppery; prothoracic margins narrow; elytral apices unarmed; in general without striking characters; length *c.* 8.5–10 mm.

Types. Of *elegans*, from **Sumatra** (collected by Doldorf), present location of type unknown; of *amoenus*, from Dorey, **West N. G.**, now in Oberthür Coll., Paris Mus.; of *obliquatus*, from **New Britain**, presumably now in Paris Mus. (none seen).

Occurrence in New Guinea. Very common (about 200 specimens) throughout **New Guinea**, chiefly at low altitudes (including Dobodura), but reaching 1700 m near Wau.

Notes. The range of *elegans*, including its supposed subspecies and varieties (which need further study), is from **SE. Asia** to **Australia**, east at least to the **Philippines** and **Solomons**.

The name *obliquatus* Fairmaire has been

overlooked by most authors, and the citation in Csiki is incorrect. The description clearly is based on a small specimen of the present species, which is common in **New Britain**.

Catascopus brunneus n. sp.

Description. With characters of genus; form as in Figure 59, compact and convex (in genus); brown, subaeneous, appendages brown; rather shining, reticulate microsculpture faint on head, light on pronotum and elytra. *Head* large, 0.97 and 0.97 width prothorax; front irregularly sculptured and in part sparsely punctulate. *Prothorax* square-cordate; width/length 1.38 and 1.37; base/apex 1.01 and 0.96; margins moderate; disc lightly transversely strigulose and punctulate. *Elytra*: width elytra/prothorax *c.* 1.53 and 1.59 (but elytra warped so measurements inexact); humeri very prominent, almost subangulate (narrowly rounded) anteriorly; apices oblique, scarcely sinuate, with outer angles scarcely indicated (very broadly rounded) and sutural angles narrowly rounded and sometimes minutely denticulate; striae well impressed, faintly punctulate; no intervals specially elevated at base. *Measurements*: length *c.* 12–13; width *c.* 4.4–5.0 mm.

Types. Holotype ♂ (Bishop Mus.) and 1 ♀ paratype from Goilala, Tapini, Owen Stanley Rge., **Papua**, 975 m, Nov. 16–25, 1957; and 2 additional paratypes (M.C.Z., Type No. 31,408) from Goilala, Loloipa, Owen Stanley Rge., Jan. 16–30, Feb. 1–15, 1958 (all these specimens, W. W. Brandt); 1 paratype (S. Australian Mus.), Wareo, Finschhafen, **N-E. N. G.** (L. Wagner).

Measured specimens. The ♂ holotype and 1 ♀ paratype from Loloipa.

Notes. This species is unusual in its rather compact form, plain brown-aeneous color, and simple elytral apices (except for minute, variable denticles near sutural angles). So far as I know, it is not closely related to any previously described species. Characters distinguishing it from other species are given in the preceding *Key*.

Catascopus latus n. sp.

Description. With characters of genus; form as in Figure 60, very broad, depressed; head and pronotum dark green, elytra purple, lower surface and appendages reddish black; head and pronotum shining with reticulate microsculpture absent or faint, elytra dull and closely microreticulate. *Head* 0.87 width prothorax; front flat, broadly irregularly impressed. *Prothorax* wide-subcordate; width/length 1.77; base/apex 0.97; side margins rather narrow (in relation to width of prothorax), moderately reflexed, left with 3, right with 2 formerly-seta-bearing punctures at and before middle. *Elytra*: width elytra/prothorax 1.36; humeri broad but margin not thickened and not subangulate; margins rather narrow; outer-apical angles prominent, slightly acute; apices with moderate spines *c.* opposite ends sutural striae; striae moderately impressed, scarcely punctulate; intervals not elevated at base, punctulate especially along middle, 3rd with only 2 dorsal punctures, less than ¼ from base and near or behind middle (position unsymmetric). *Measurements*: length 17.5; width 6.3 mm.

Type. Holotype ♀ (British Mus.) from W. Tami R., Pukusan-Humboldt Bay Dist., **West N. G.,** June 1937 (W. Stüber); the type is unique.

Notes. This striking and thoroughly distinct species is sufficiently compared with others in the *Key to Species of Catascopus of New Guinea.*

Catascopus laevigatus Saunders

Saunders 1863, Trans. Ent. Soc. London (3) 1, p. 458, pl. 18, fig. 2a-b.

Csiki 1932, Coleop. Cat., Carabidae, Harpalinae 7, p. 1365 (see for additional references).

Description (for recognition only). With characters of genus; wide and depressed; green, shining; elytra with sutural angles spined, outer-apical elytral angles *c.* right; length *c.* 10–11 mm.

Types. From "**Batchian**, **Ternate** and **Aru**. Wallace," type now in Oberthür Coll. Paris Mus. (not seen).

Occurrence in New Guinea. Twenty-four, from numerous localities in all 3 political divisions of **New Guinea**; occurs at Dobodura and up to 1200 m at Wau.

Notes. I have seen specimens also from the **Aru Is.** and from **Buru**, **Ceram**, and **Halmahera** (Jilolo) in the **Moluccas**. The closely related *C. laticollis* Macleay of North Queensland (Kuranda and Atherton Tableland, and Coen-Rocky Scrub areas) represents the species in Australia.

Catascopus sidus n. sp.

Description. With characters of genus; form as in Figure 61; rather wide but less depressed than *laevigatus*; green, elytra blue purple with green humeri (at Wau) or *c.* wholly green (Star Rge.) or *c.* wholly purple (Japen Is.), lower surface and appendages dark brown; shining, reticulate microsculpture faint on front and on disc of pronotum, distinct on elytra. *Head* 0.93, 0.90, 0.92 width prothorax; front irregularly impressed at middle, sparsely minutely (scarcely detectably) punctulate. *Prothorax* transverse-cordate with wide base; width/length 1.57, 1.61, 1.47; base/apex 1.14, 1.13, 1.13; side margins broader and more reflexed than in *laevigatus*, each with *c.* 6 strong setae (or punctures) in anterior ⅗; disc almost without transverse strigulation, faintly and sparsely (hardly detectably) punctulate. *Elytra*: width elytra/prothorax *c.* 1.49, 1.54, 1.57; humeri prominent but with margins rounded (not widened and subangulate as in *laevigatus*); outer-apical angles well defined, *c.* right or nearly so; apices with short spines not quite at sutural angles; striae well impressed, scarcely punctate (more impressed but less punctate than in *laevigatus*); intervals scarcely elevated at base. *Secondary sexual characters* as described for genus. *Measurements*: length *c.* 12–13; width 4.6–5.1 mm.

Types. Holotype ♂ (Bishop Mus.) from Wau, Morobe Dist., **N-E. N. G.,** 1200 m, Sept. 15–30, 1962 (Sedlacek); 1 ♂ paratype, same locality, 1250 m, Sept. 16, 1962 (Sedlaceks); 1 paratype, Mt. Missim (near Wau), 1600 m, Mar. 17, 1966; 7 paratypes, Wau Ck., 1200–1500 m, Sept. 16–18, 1964 (M. Sedlacek) (some paratypes in M.C.Z., Type No. 31,409).

Additional material. **West N. G.**: 1 ♂, Sibil, Star Rge., 1260 m, May 16, 1959 (Leiden Mus.), at light; 1 ♂, Mt. Baduri, Japen Is., 1000 ft. (305 m), Aug. 1938 (Cheesman).

Measured specimens. The ♂ holotype and the ♂ ♂ from Star Rge. and Japen Is., in this order.

Notes. Although similar to *laevigatus*, *sidus* is more convex, with wider and more reflexed prothoracic margins, and other differential characters noted in the preceding description. The single specimens from Star Rge. and Japen Is. differ from the types in color of elytra (see *Description*, above) but I do not wish to call them subspecies without seeing more material.

Catascopus smaragdulus Dejean

Dejean 1825, Species Général Coléop. 1, p. 331. Csiki 1932, Coleop. Cat., Carabidae, Harpalinae 7, p. 1366 (see for additional references and synonymy, which do not concern New Guinea).

Description (for recognition only). With characters of genus; small, rather broad; green or partly coppery; prothorax with margins wider than in *elegans* and set off by submarginal longitudinal swellings; elytra with outer-apical angles rounded or bluntly obtuse, apices each with an acute tooth or short spine; intervals not elevated at base; length 8 mm or less.

Type(s). From **Java**; now in Oberthür Coll., Paris Mus. (not seen).

Occurrence in New Guinea. Seventeen specimens from localities in all 3 political divisions of New Guinea and from Normanby Is.; at low altitudes only.

Notes. C. smaragdulus ranges from the southern corner of **Asia** (**Burma**, etc.) to **New Guinea**, **New Britain**, and the northeastern corner of **Australia** (specimens from the Rocky Scrub, mid-peninsular Cape York, taken by me in June 1932).

In this species the width of the prothorax

and the development of elytral spines vary both individually and, I think, geographically, but I do not have enough material from outside New Guinea to define satisfactory subspecies.

Catascopus dobodura n. sp.

Description. With characters of genus; form (Fig. 62) *c.* average with elytra rather wide but convex; green, elytra sometimes greenish castaneous or purplish laterally, lower surface almost black, appendages dark brown; shining, reticulate microsculpture absent or nearly so on front, pronotum, and disc of elytra, indicated toward sides and apex of elytra. *Head* 1.01 and 1.01 width prothorax; front slightly depressed anteriorly and longitudinally impressed each side. *Prothorax* quadrate-subcordate; width length 1.44 and 1.42; base/apex 1.08 and 1.04; sides broadly rounded anteriorly with anterior angles only a little advanced, strongly sinuate *c.* ¼ of length before right or slightly acute basal angles; side margins very narrow, not set off by longitudinal swellings, each with usual seta at basal angle and 1 median-lateral seta just before middle; basal transverse impression deep (as usual) but basal marginal line obsolete at middle; disc with faint transverse strigae and faint sparse punctulation. *Elytra*: width elytra/prothorax — and 1.59 (elytra of ♂ too spread to measure); lateral margins moderate; outer-apical angles *c.* right or slightly obtuse but distinct, apices each with spine *c.* opposite end 2nd interval; striae moderately impressed, faintly punctulate; intervals not elevated at base. *Measurements*: length *c.* 9–10; width *c.* 3.4–3.8 mm.

Types. Holotype ♂ (M.C.Z., Type No. 31,410) from Oro Bay, **Papua**, Dec. 1943–Jan. 1944 (Darlington); and 1 ♀ paratype from Dobodura (near Oro Bay), Mar.–July 1944 (Darlington).

Other material. One ♀, Kiunga, Fly R., July 23–25, 1957 (W. W. Brandt, Bishop Mus.).

Measured specimens. The types.

Notes. It is surprising to find a new, medium-small, green *Catascopus* at low altitudes in Papua, but the species seems clearly distinct. In form (except that it is a little broader) and narrow prothoracic margins it resembles *elegans* but is immediately distinguished by spined elytral apices, reduction of microreticulation of elytra, and in other ways. In form of elytral apices and reduction of microreticulation it somewhat resembles *laevigatus* but is more slender and convex, with only 1 median-lateral pronotal seta on each side. The virtual obliteration of the middle part of the posterior marginal line of the pronotum is diagnostic of this new species.

Catascopus biroi n. sp.

Description. With characters of genus; form as in preceding species (*dobodura*); green or blue-green, with some coppery color at sides of elytra especially behind humeri, lower surface and appendages brown or brownish black; moderately shining, front and disc of pronotum with reticulate microsculpture absent or very light, but disc of elytra entirely (transversely) microreticulate. *Head* 0.99 and 1.00 width prothorax; front flat, slightly irregularly depressed, and with (usual) longitudinal impression each side. *Prothorax* quadrate-subcordate; width length 1.41 and 1.34; base/apex 1.13 and 1.08; sides broadly arcuate anteriorly, sometimes faintly angulate at median-lateral seta, sinuate slightly less than ¼ before right or slightly acute basal angles; lateral margins narrow but paralleled by slightly swollen ridges accentuating the marginal channels, each with usual seta at basal angle and 1 median-lateral seta slightly before middle; basal marginal line entire in all specimens. *Elytra*: width elytra/prothorax 1.63 and 1.58; outer-apical angles sharply defined, right or slightly acute; apices each with short spine near but not quite at sutural angle; striae well impressed, slightly punc-

tulate; intervals convex, not elevated at base, punctulate. *Measurements* (of types): length 8.7–9.3; width 3.5–3.7 mm.

Types. Holotype ♂ (Hungarian National Mus.) and 2 paratypes from Stephansort, Astrolabe Bay, **N-E. N. G.,** 1897 (Biró); and 1 paratype, Erima, Astrolabe Bay, 1897 (Biró). (Two paratypes now in M.C.Z., Type No. 31,411.)

Additional material. **West N. G.**: 1, Waigeu Is., Camp 1, Mt. Nok, 2500 ft. (*c.* 760 m), May 1938 (Cheesman). This specimen is a ♂ larger than the types (*c.* 11 mm) and with disc of pronotum more distinctly microreticulate, but it seems clearly referable to *biroi*.

Measured specimens. The ♂ holotype and 1 ♀ paratype from Stephansort.

Notes. This is another medium-small, green species presumably related to the preceding one (*dobodura*) but differing in a number of details, including entire basal marginal line of pronotum, presence of distinct reticulate microsculpture on disc of elytra, and position of elytral spines, which are closer to the suture in *biroi* than in *dobodura*.

Catascopus wallacei group

Catascopus wallacei Saunders and its immediate relatives, including all the remaining New Guinean species of the genus, treated below, form an apparently natural group of large, often conspicuously colored species characterized by having both sutural and outer-apical elytral angles acutely toothed or spined and by having a longitudinal zone of dense, conspicuous pubescence along the midline of the body, from prosternum almost to the tip of the abdomen in the ♂ but mainly on the sterna in the ♀. Otherwise the species of this group share the characters stated under the genus, with minor exceptions.

The *wallacei* group of *Catascopus* centers on New Guinea, where 5 species are now known. Most of them are sympatric: 4 of the 5 species have been found at Wau. Of the 5 New Guinean species, *aruensis* and *wallacei* each reach one or more small islands to the west (Aru Is., Waigeu, Mysol), and *aruensis* reaches also New Britain, New Ireland, and Cape York in Australia. A sixth species of the group (*chaudoiri* Castelnau) is endemic in northern Australia.

Some species of this group vary individually in form especially of the prothorax, in degree of elevation of the 5th elytral intervals, and in some other details. Although I can clearly recognize only the 5 species treated below, Straneo (see references under the species) has distinguished others, and he may be right. A thorough study of long series will be required to decide this, including study of genitalic characters, which are indicated by Straneo. I am, incidentally, very much indebted to Prof. Straneo for loan of paratypes of his 3 species of this group.

Catascopus aruensis Saunders

Saunders 1863, Trans. Ent. Soc. London (3) 1, p. 458, pl. 17, fig. 5a-b.

Csiki 1932, Coleop Cat., Carabidae, Harpalinae 7, p. 1362 (see for additional references and partial synonymy).

Straneo 1943, Ann. Mus. Civ. Genoa 61, p. 302.

Jedlicka 1963, Ent. Abhandlungen 28, pp. 382, 393.

cupricollis Chaudoir 1883, in R. Oberthür, Coleopterorum Novitates 1, p. 24 (not *cupricollis* Waterhouse 1877).

brevispinosus Sloane 1910, Proc. Linnean Soc. New South Wales 35, pp. 398, 400 (new synonymy).

aeneicollis Andrewes 1919, Ann. Mag. Nat. Hist. (9) 3, p. 481 (new name for *cupricollis* Chaudoir).

Andrewes 1924, Ann. Mag. Nat. Hist. (9) 14, p. 593.

?*dalbertisi* Straneo 1943, Ann. Mus. Civ. Genoa 61, p. 304.

Description. With characters of genus and of *wallacei* group (above); green or blue-green (elytra rarely purplish); prothorax more square (less cordate) than in *wallacei*, but somewhat variable; elytra with outer-apical angles spined, sutural angles with shorter spines or simply acute

(variable); 5th intervals not or not much elevated near base (slightly variable), 7th intervals subcarinate at base; length *c.* 13–15.5 mm.

Types. Of *aruensis* Saunders, from "**Aru** [**Is.**]. Wallace," now in Oberthür Coll., Paris Mus. Of *cupricollis* Chaudoir, from Fly R., **New Guinea**, now also in Oberthür Coll., Paris Mus. Of *brevispinosus* Sloane, from Coen, Cape York, **Australia**, now in Sloane Coll., Canberra. Of *dalbertisi* Straneo, holotype from Hatam, **Papua**, in Genoa Mus., and allotype from Andai, **Papua**, in Straneo Coll. (See *Notes*, below.)

Occurrence in New Guinea. Widely distributed but much less common than *wallacei* (below): 27 specimens, from all 3 political divisions of **New Guinea** and from Normanby Is.; most from low altitudes but reaching 1200 m at Wau.

Notes. Outside New Guinea this species occurs on the **Aru Is.** (type locality), **New Britain**, **New Ireland**, and Cape York, **Australia** (types of *brevispinosus*). Possibly some of the outlying populations may be distinguishable as subspecies.

Of the types listed above, I have seen only those of *brevispinosus* (briefly in 1957, but Dr. B. P. Moore has sent me additional notes on them) and the allotype of *dalbertisi* (through the kindness of Prof. Straneo).

Catascopus wallacei Saunders

Saunders 1863, Trans. Ent. Soc. London (3) 1, p. 462, pl. 17, fig. 4a-b.

Csiki 1932, Coleop. Cat., Carabidae, Harpalinae 7, p. 1367 (see for additional references).

Straneo 1943, Ann. Mus. Civ. Genoa 61, p. 302, fig. a.

Jedlicka 1963, Ent. Abhandlungen 28, pp. 382, 393.

?*beccarii* Straneo 1943, Ann. Mus. Civ. Genoa 61, p. 303, fig. b.

Description. With characters of genus and of *wallacei* group (above); usually brightly bicolored, with head and elytra purple and prothorax brassy or coppery, but coloration sometimes duller; prothorax a little more subcordate (less square) than in *aruensis*, with posterior angles more prominent and more acute; elytra with sutural as well as outer-apical angles spined; 5th and 7th intervals elevated near base (slightly variable, especially the 5th); length *c.* 15–20 mm.

Types. Of *wallacei* Saunders, from "Wagiou [**Waigeu**], **Dorey** and **Mysol**"; actual (holo)type now in Oberthür Coll., Paris Mus. (not seen). Of *beccarii* Straneo, holotype from Hatam, **Papua**, in Genoa Mus., and allotype from Andai, **Papua**, in Straneo Coll. (allotype seen).

Occurrence in New Guinea. Common probably throughout **New Guinea**: 176 specimens before me (including 82 from Dobodura); most from low altitudes, but reaching 1300 m near Wau.

Notes. This beautiful carabid is apparently confined to **New Guinea** and zoogeographically closely associated islands including **Aru Is.**, **Waigeu**, and **Mysol**. It apparently does *not* reach the Moluccas proper, nor New Britain, nor Australia.

Most of the individuals from Dobodura were trapped under strips of burlap laid across the trunks of fallen trees in rain forest.

Catascopus strigicollis Straneo

Straneo 1943, Ann. Mus. Civ. Genoa 61, p. 305, fig. c.

Description. With characters of genus and of *wallacei* group, except ♂ as well as ♀ with 2 or 3 setae each side last ventral segment; bicolored, head and prothorax green or slightly coppery, elytra purple or (especially basally) bluish or greenish; prothorax almost square except sides sinuate posteriorly (as usual in group); elytra with rather short spines at outer-apical angles and still shorter (slightly variable) ones at sutural angles; 5th as well as 7th intervals raised near base; length *c.* 15–18 mm.

Types. Holotype (Genoa Mus.) and allotype (Straneo Coll.) both from Andai, **Papua**, Aug. 1872 (D'Albertis). I have examined the allotype, loaned by courtesy of Prof. Straneo.

Occurrence in New Guinea. **Papua**: the types. **N-E. N. G.**: 21, Wau, Morobe Dist., altitudes from 900 to 1500 m, dates in Mar., Apr., May, July, Aug., Sept., Oct., Dec., 1961–1964 (Sedlaceks); 1, Sattelberg, Huon Gulf, 1899 (Biró); 1, Wareo, Finschhafen (L. Wagner, S. Australian Mus.).

Notes. This seems to be a distinct species, immediately distinguished from *wallacei* by head colored like pronotum (not like elytra), elytral spines shorter, and other details, and from *aruensis* by 5th elytral intervals raised, size usually larger, and ♂ with additional apical ventral setae. It *may* occur mainly in mountains rather than in lowlands, and it *may* be confined to part of eastern New Guinea, but further collecting is needed to confirm these possibilities.

Catascopus taylori n. sp.

Description. With characters of genus and of *wallacei* group; form (Fig. 63) of large *wallacei*; head black or very dark blue, prothorax brassy or slightly coppery, elytra blue purple, lower surface and appendages dark; head and pronotum rather shining with reticulate microsculpture absent or weak, elytra duller with close, slightly transverse reticulate microsculpture. *Head* 0.77 and 0.81 width prothorax, impressed across base; front with usual 2 longitudinal impressions and slightly sculptured and irregularly punctulate posteriorly. *Prothorax* quadrate-subcordate; width/length 1.55 and 1.51; base/apex 1.08 and 1.10; sides broadly arcuate anteriorly with anterior angles flattened and roundly produced, very broadly sinuate posteriorly to right or acute slightly denticulate posterior angles; side margins rather wide (at widest point of prothorax, width of the flattened margin is *c.* ⅐ width from outer edge of margin to midline of pronotum), flattened, reflexed, each with usual seta at basal angle and 1 before middle; disc finely transversely strigulose, sparsely and faintly punctulate. *Elytra* long, *c.* as in *wallacei*; width elytra/prothorax 1.42 and 1.34; outer-apical angles spined, sutural angles acutely produced or spined (individual variation); striae well impressed, faintly punctulate; 5th and 7th intervals elevated near base. *Secondary sexual characters* normal for genus; ♂ with 1, ♀ 2 setae each side last ventral segment. *Measurements*: length *c.* 17–22; width *c.* 5.8–7.1 mm.

Types. Holotype ♂ (M.C.Z., Type No. 31,412) from Aiura, **N-E. N. G.,** 1900 m, July 1962 (R. W. Taylor, #2147), in rain forest; additional paratypes as follows. **N-E. N. G.**: 4, Mt. Missim, Wau, Morobe Dist., 950–1000, 1500, 1600–2000 m, Dec. 28, 1961, Aug. 10, Sept. 21–24, 1964 (Sedlaceks); 1, Eliptamin Vy., 1200–1350 m, Aug. 16–30, 1959 (W. W. Brandt, Bishop Mus.); 4, Wareo, Finschhafen (L. Wagner, S. Australian Mus.); 1, Moife, 15 km NW. of Okapa, 2100 m, Oct. 7–14, 1959 (T. C. Maa, Bishop Mus.); 2, Okapa, E. Highlands, Apr. 20, 1964 (Hornabrook); 2, 13 km SE. Okapa, 1650–1870 m, Aug. 26, 1964 (Sedlaceks); 2, Morae, Kukukuku [Rge.], E. Highlands, 6000 ft. (*c.* 1850 m), Mar. 1, 1964 (Hornabrook). **West N. G.**: 3, Wissel Lakes, Arabu Camp, 1800 m, Oct. 7, 1939 (H. Boschma, Leiden Mus.); 1, Wissel Lakes, Enarotadi, 1800–1900 m, Aug. 10, 1963 (Sedlacek).

Measured specimens. The ♂ holotype and ♀ paratype from Enarotadi.

Notes. This new species seems close to *wallacei*, from which it differs mainly in its wider prothoracic margins. The difference is striking on comparison of specimens. Mainly because the prothoracic margins are wider, the present new species has a relatively narrower head and wider prothorax as shown by measurements: in a measured ♂ of *wallacei* the head is 0.90 width prothorax and the prothoracic width/length is 1.40. Also, *taylori* averages larger than *wallacei* and usually occurs at higher altitudes.

Catascopus rex n. sp.

Description. With characters of genus and of *wallacei* group; form as in Figure 64; broad with very broad prothorax; green,

front and elytra bluish green, lower surface and appendages brownish black; head roughened and closely microreticulate posteriorly, more shining but slightly strigulose anteriorly, pronotum and elytra duller, closely slightly transversely microreticulate. *Head* large, but only 0.78 and 0.83 width prothorax; depressed across base, with usual longitudinal impression each side anteriorly. *Prothorax* transverse-cordate, very wide but with relatively narrow base; width/length 1.76 and 1.67; base/apex 0.90 and 0.89; side margins rather broad especially anteriorly and with anterior angles flattened and advanced, each with posterior and 1 median-lateral seta, latter slightly farther forward than usual. *Elytra*: width elytra/prothorax 1.23 and 1.29; outer-apical and sutural angles both with short spines; striae well impressed, scarcely punctulate; intervals convex, slightly punctulate, 7th carinate at base, others slightly humped but not carinate. *Secondary sexual characters* of ♂ normal for genus; ♀ unknown. *Measurements*: length *c.* 20; width 6.7–6.8 mm.

Types. Holotype ♂ (Bishop Mus.) from Mokai Village, Torricelli Mts., **N-E. N. G.,** 750 m, Dec. 8–15, 1958 (W. W. Brandt); and 1 ♂ paratype (M.C.Z., Type No. 31,413) from Kiunga, Fly R., **Papua**, Sept. 24–25, 1957 (W. W. Brandt).

Notes. Within the *wallacei* group, the large size and very broad, cordate prothorax immediately distinguish this striking species.

Genus *PERICALUS* Macleay

Macleay 1825, Annulosa Javanica, p. 15.
Csiki 1932, Coleop. Cat., Carabidae, Harpalinae 7, p. 1368 (see for synonymy and additional references).
Jeannel 1949, Coléop. Carabiques de la Région Malgache, Part 2, p. 1007 (in text).
Jedlicka 1963, Ent. Abhandlungen 28, p. 373.

Diagnosis. Similar to *Catascopus* (labrum emarginate, ligula-paraglossae similar, 4th hind-tarsal segments scarcely emarginate, claws simple, etc.) but eyes more abruptly prominent; clypeus truncate; elytra usually with geometric color pattern; size usually smaller.

Description. None required here.

Type species. Pericalus cicindeloides Macleay, of Java, etc.

Generic distribution. Confined to, but widely distributed and diverse in, tropical **Asia** and the **Malay Archipelago**, reaching **New Guinea** and **New Britain** but not Australia.

Notes. The genus is represented in New Guinea by only the following species (*figuratus*), and on New Britain by a different, endemic species (*klapperichi* Jedlicka 1953, Ent. Blätter 49, p. 145).

Pericalus figuratus Chaudoir

Chaudoir 1861, Berliner Ent. Zeitschrift 5, p. 124.

Description. None required here; the form (Fig. 65) and elytral markings make this insect unmistakable, in New Guinea; length *c.* 7–8 mm.

Type. Supposedly from **Celebes**, collected by Wallace; now in Oberthür Coll., Paris Mus. (not seen).

Occurrence in New Guinea. Common (more than 150 specimens) probably throughout the island at low altitudes, and occurring up to 1320 m near Wau.

Notes. So far as I know, this insect has not been found in Celebes since Wallace's time, and it has not been recorded from the Moluccas. I think it is possible that the type really came from New Guinea and that the species is endemic there. It lives on tree trunks and recently fallen logs in rain forest.

Genus *COPTODERA* Dejean

Dejean 1825, Species Général Coléop. 1, p. 273.
Csiki 1932, Coleop. Cat., Carabidae, Harpalinae 7, p. 1370 (see for additional references, synonymy, and list of species).
Jeannel 1949, Coléop. Carabiques de la Région Malgache, Part 3, pp. 924, 926.
Jedlicka 1963, Ent. Abhandlungen 28, p. 341.
Ectinochila Chaudoir 1883, Coleopterorum Novitates 1, p. 21 (new synonymy).
?*Trichocoptodera* Louwerens 1958, Treubia 24, p. 255.

Diagnosis. See *Key to Genera of Lebiini of New Guinea.*

Description. Form (Figs. 66–70) broad, ± depressed; upper surface not pubescent (in New Guinean species). *Head*: eyes prominent; 2 setae over each eye; front impressed each side anteriorly; clypeus with 1 seta each side; labrum variable, usually rather long, subtruncate or slightly emarginate at apex, 6-setose; antennae with 3½ segments glabrous; mentum without tooth; ligula 2-setose, paraglossae attached to but much longer than ligula, broadly rounded, without setae at apex but with small setae at sides. *Prothorax* broadly subcordate (except in *grossa*), with base sometimes lobed, usually not; 2 setae each side, at basal angle and before middle; disc with usual impressions. *Elytra* broad; humeri broadly rounded but rather prominent; apices with outer-apical angles rounded, sutural angles variable; striae entire, not distinctly punctate; intervals convex but none specially elevated; 3rd intervals with 2–4 seta-bearing punctures (if 4, near base on outer edge, *c.* ¼ from base on outer edge, behind middle on inner edge, and near apex usually on inner edge), but one or both intermediate punctures missing in some species. *Inner wings* full. *Lower surface*: prosternum usually with a little sparse pubescence, abdomen not pubescent. *Legs* slender; 4th hind-tarsal segments simply emarginate; 5th tarsal segments with accessory setae; claws with 3 or 4 teeth. *Secondary sexual characters*: ♂ front tarsi slightly dilated, with 3 segments 2-seriately squamulose, and ♂ middle tarsi with 2 segments squamulose in some (not all) species; ♂ middle tibiae with 1 or 2 excisions on inner edge near apex in most species (see *Notes*, below); 2 setae each side apex last ventral segment in both sexes.

Type species. Of *Coptodera, C. festiva* Dejean, of Cuba; of *Ectinochila, E. tesselata* Chaudoir [= *aurata* (Macleay)], of Australia; of *Trichocoptodera, T. maculata* Louwerens, of Celebes.

Generic distribution. In a broad sense, the genus is **pan-tropical**. (In Jeannel's restricted sense, *Coptodera* proper is confined to the Americas, and related Old World forms are divided into several genera.) In the Asiatic-Australian area, species of the genus (*sensu lato*) are numerous from southeastern Asia including Japan across the whole Malay Archipelago, and a few occur in Australia and New Caledonia. For further details see *Notes*, below.

Notes. Jeannel (1949) divides *Coptodera* (*sensu lato*) and its immediate allies into a number of small genera based primarily on genitallic characters. It seems to me that in this case, as in many others, Jeannel has carried generic splitting beyond the limit of usefulness. I have not attempted to check the genitallic characters, which would require dissection of many species from many parts of the world. But I can say that, if Jeannel's concept of genera were applied to the New Guinean species, I would have to divide *Coptodera* into about 5 genera, 2 or 3 of which would be new. The new names would be meaningless except to extreme specialists, and the fine splitting would hide the broader relationships and geographic patterns of the group. By treating the diverse New Guinean species as members of one genus, I emphasize what I think is a fact, that the group is a natural one even though the species are diverse, and that it has a pan-tropical distribution. The most useful taxonomic treatment in the end may be to retain *Coptodera* in a broad sense but to divide it into a reasonable number of natural subgenera. This should, of course, be done on a worldwide basis, not in a local faunal work.

Certain characters do vary remarkably in this genus. The larger New Guinean species, which are more typical of *Coptodera*, have the base of the prothorax subtruncate, sometimes slightly oblique toward the sides but not lobed. However, in 2 smaller New Guinean species (*papuella* and *wau*), the

base of the prothorax does have a distinct short basal lobe. And in the Australian "*Ectinochila*" *tesselata*, the base of the prothorax is more strongly lobed. All these species have similar, diagnostic mouthparts (mentum without tooth, and ligula and paraglossae as described), and the small New Guinean species are transitional in other ways: they have wider prothoracic margins and look more like *Coptodera* than *Ectinochila tesselata* does, and *papuella* has elytral markings like some more-typical *Coptodera*, but both *papuella* and *wau* approach *Ectinochila* in dense dorsal microsculpture, and *wau* has *Ectinochila*-like elytral markings.

The dorsal elytral punctures confirm this relationship. The number of punctures varies in *Coptodera*. The full number is 4 on each 3rd interval, placed *c.* as noted in the preceding *Description*. This is the arrangement in the type species of the genus (*C. festiva* Dejean, of Cuba) and in some of the more or less typical New Guinean species, e.g., *cyanella* and *eluta*. However, *grossa* and *lineolata* have the 3rd intervals 3-punctate (puncture at basal ¼ missing), and *oxyptera* has the 3rd intervals only 2-punctate (both median punctures missing, leaving only the subbasal and subapical ones). But the *Ectinochila*-like New Guinean species (*papuella* and *wau*) and also the Australian *E. tesselata* have the 3rd intervals 4-punctate as in typical *Coptodera*.

The excisions of the ♂ middle tibiae also confirm the relationship of *Ectinochila* to *Coptodera*. The ♂ middle tibiae have a single small excision (like that in *Lebia*) in inner edge near apex in the Cuban type species of *Coptodera* (*festiva*), in most New Guinean species of the genus including the *Ectinochila*-like ones, and in the Australian *E. tesselata*. However, 2 non-*Ectinochila*-like New Guinean species are different: *Coptodera oxyptera* has 2 small excisions on each ♂ middle tibia (like *Aristolebia*), and *C. ornatipennis* has none.

Most *Coptodera* have the dorsal surface glabrous, but "*Trichocoptodera*" *maculata* Louwerens of Celebes has the pronotum sparsely pilose. *Coptodera ornatipennis* Louwerens of the Moluccas seems closely related, and a paratype of it (which I owe to the generosity of Mr. Louwerens) has a few inconspicuous fine hairs still on the pronotal disc. Specimens that I assign to this species from New Guinea seem to lack pronotal pubescence, but the hairs may be rubbed off (in light-trap specimens) or be adhering invisibly to the pronotal surface (in specimens mounted from alcohol). However, although I have listed *Trichocoptodera* as a possible synonym of *Coptodera*, it may eventually prove worth recognition as a separate genus or subgenus, distinguished by ♂ middle tibiae without excisions and perhaps by other characters.

The 8 species of *Coptodera* in New Guinea represent 7 stocks with different, independent geographic distributions. (1) *C. grossa* is endemic and without close relatives anywhere, so far as I know. (2) *C. ornatipennis* occurs in the Moluccas as well as New Guinea, with an apparent relative on Celebes. (3) *C. cyanella* represents the *flexuosa* group, which ranges from SE. Asia to Australia (the Australian species being *australis* Chaudoir). (4) *C. lineolata* ranges from Celebes to New Guinea and New Britain, and an apparently related species (*mastersi* Macleay) is in Australia. (5) *C. eluta* apparently occurs from SE. Asia to New Guinea and New Britain, and (6) *C. oxyptera*, from Celebes to New Guinea, New Britain, and New Ireland; these species are not represented in Australia. And (7) *C. papuella* and *wau* are endemic to New Guinea, probably related to each other, and less closely related to "*Ectinochila*" *aurata* of Australia.

Most of the common *Coptodera* in New Guinea inhabit tree trunks and recently fallen logs in rain forest. However, a few species of the genus elsewhere live among dead leaves on the ground, and this may be

the habitat of some of the less common New Guinean ones.

KEY TO SPECIES OF *COPTODERA* OF NEW GUINEA

1. Prothorax not lobed at base; dorsal microreticulation moderate or partly absent; larger (usually 5 mm or more, excepting small individuals of *lineolata*) 2
– Prothorax lobed at base; dorsal microreticulation close, heavily impressed; smaller (3.5–4.8 mm) 7
2. Very large (8.5–9.5 mm); form as in Figure 66, with very long mandibles and transverse prothorax (p. 113) *grossa*
– Smaller; mandibles relatively shorter; prothorax ± subcordate 3
3. Head and disc of pronotum not microreticulate; each elytron with 2 irregular, ± transverse pale blotches (Fig. 67); ♂ middle tibiae without excisions (p. 113) *ornatipennis*
– Head and disc of pronotum microreticulate (lightly so in *oxyptera*); ♂ middle tibiae with excision(s) on inner edge near apex 4
4. Elytra with sutural angles blunt, narrowly rounded; elytra usually (not always) conspicuously spotted or striped with pale 5
– Elytra with sutural angles acute, often denticulate; elytra unmarked or with only a few inconspicuous minute pale flecks 6
5. Each elytron with 3 irregular pale blotches sometimes joined to form an irregular longitudinal stripe (p. 114) *cyanella*
– Elytra usually with numerous, more or less separate, longitudinal pale lines (Fig. 68) but pale pattern somewhat variable, sometimes almost obliterated (p. 114) *lineolata*
6. Very broad; elytral striae less impressed; color dark without pale markings; 3rd elytral intervals with only 2 (subbasal and subapical) punctures (p. 115) *oxyptera*
– Less broad; elytral striae deeply impressed; elytra usually with minute pale flecks; 3rd intervals 4-punctate (p. 115) *eluta*
7. Front of head heavily microreticulate but not longitudinally rugulose; elytra irregularly 2-fasciate with pale (p. 115) *papuella*
– Front of head in part longitudinally rugulose as well as microreticulate; elytra with a large, common, irregular X-shaped pale area (Fig. 70) (p. 116) *wau*

Coptodera grossa n. sp.

Description. With characters of genus; form as in Figure 66; very large; reddish black, appendages brown; shining, elytra faintly silky or subiridescent, reticulate microsculpture absent or faint on front and on disc of pronotum, distinct (but lightly impressed) and transverse on elytra. *Head* 0.73 and 0.72 width prothorax; mandibles exceptionally long, nearly straight; clypeus rounded at sides, sinuately emarginate at middle; labrum very long, narrowed anteriorly, obtusely emarginate; front almost smooth posteriorly, slightly punctate anteriorly, as is clypeus. *Prothorax* very wide, formed as in Figure 66; width/length 1.93 and 1.82; base/apex 1.49 and 1.44; base not lobed; side margins narrow, each with seta almost at basal angle and less than ¼ from apex (farther forward than usual); basal and apical marginal lines entire; disc almost without punctation or strigae. *Elytra* wide; width elytra/prothorax *c.* 1.67 and 1.65; apices slightly obliquely sinuate, outer-apical angles rounded, sutural angles blunt or subdenticulate; striae well impressed, punctulate; intervals convex, finely and sparsely punctulate, 3rd with subbasal and subapical seta-bearing punctures and 1 intermediate puncture on inner edge behind middle. *Secondary sexual characters*: as of genus except ♂ with squamae on front tarsi only (not on middle tarsi); ♂ middle tibiae with 1 excision; ♂ copulatory organs as in Figure 176. *Measurements*: length *c.* 8.5–9.5; width 4.0–4.7 mm.

Types. Holotype ♀ (M.C.Z., Type No. 31,414) from Dobodura, **Papua**, Mar.–July 1944 (Darlington). Paratypes from **N-E. N. G.**: 1 ♂ (Bishop Mus.), Wau (Mt. Missim), Morobe Dist., 1100 m, July 22, 1961 (Sedlaceks); 2, Karimui, 1080 m, July 13, 1963 (Sedlacek); 1, Wareo, Finschhafen (L. Wagner, S. Australian Mus.).

Measured specimens. The ♂ paratype from Wau and the ♀ holotype.

Notes. Although this species scarcely looks like a *Coptodera*, it has the essential characters of the genus. It is distinguished from other New Guinean species in the preceding *Key*.

Coptodera ornatipennis Louwerens

Louwerens 1962, Tijdschrift voor Ent. 105, p. 146, fig. 9.

Description. With characters of genus;

form and markings as in Figure 67; head and pronotum reddish testaceous or reddish piceous, elytra dark with pale marks as shown, but marks somewhat variable; reticulate microsculpture absent or faint on front and on disc of pronotum, present (but light) and transverse on elytra. *Head* 0.85 and 0.86 width prothorax. *Prothorax* wide-subcordate; width/length 1.71 and 1.71; base/apex 1.19 and 1.12; base not lobed; disc with a little faint sparse punctulation, not pubescent but margins with a few short hairs near anterior angles (see following *Notes*). *Elytra*: width elytra/prothorax 1.61 and 1.62; sutural angles blunt; 3rd intervals with subbasal and subapical seta-bearing punctures but no intermediate punctures. *Secondary sexual characters*: ♂ front tarsi with 3 segments with squamae (as usual); ♂ middle tarsi with paired squamae at apex 1st segment and on 2nd segment; ♂ middle tibiae not excised. *Measurements*: length *c.* 5.0–6.5; width 2.3–2.9 mm.

Types. From Amboina, **Moluccas**; in Louwerens Coll. (1 paratype seen).

Occurrence in New Guinea. **Papua**: 1, Dobodura, Mar.–July 1944 (Darlington); 1, Kokoda, 1200 ft. (366 m), Aug. 1933 (Cheesman). **N-E. N. G.**: 3, Finschhafen, Huon Pen., 10 m, Apr. 9–16, 1963 (Sedlacek), in mercury vapor light trap; 1, Pindiu, Huon Pen., 890 m, Apr. 17, 1963 (Sedlacek), in mercury vapor light trap. **West N. G.**: 1, "Neth. New Guinea" [probably vic. Hollandia], Nov. 10, 1944 (T. Aarons, California Acad.).

Measured specimens. A ♂ from Dobodura and ♀ from Finschhafen.

Notes. This species occurs in the **Moluccas** (the types) as well as in **New Guinea**, and it seems closely related to "*Trichocoptodera*" *maculata* Louwerens of Celebes. My Moluccan paratype of *ornatipennis* actually shows vestiges of pronotal pubescence. I can see no sign of it on the New Guinean specimens, but the latter are probably all either from alcohol or from light traps. New Guinean specimens do have a few inconspicuous short setae on the prothoracic margins anteriorly, but such setae are present in *C. oxyptera* too, and very short (vestigial?) stubs of setae are visible at 80× in some other species of *Coptodera*.

I suspect that this is a ground-living rather than arboreal species.

Coptodera cyanella Bates

Bates 1869, Ent. Monthly Mag. 6, p. 74.
Csiki 1932, Coleop. Cat., Carabidae, Harpalinae 7, p. 1370 (see for synonymy and additional references).
Louwerens 1956, Treubia 23, p. 225 (Moluccas).

Description. None required here; see preceding *Key*; length ± 6–7 mm.

Type(s). From **New Guinea**, collected by Wallace (if really from New Guinea, presumably collected at Dorey); now in Oberthür Coll., Paris Mus. (not seen).

Occurrence in New Guinea. Common throughout **New Guinea** and on Normanby Is.: 181 specimens (including 81 from Dobodura and Oro Bay); most from low altitudes but up to 1200 m at Wau.

Notes. This species ranges west to the **Moluccas**, **Celebes**, and **Borneo**, and east to **New Britain**. It is apparently related to *C. flexuosa* Schmidt-Goebel, which occurs from SE. Asia to the Philippines, Celebes, etc., overlapping the range of *cyanella*. *C. australis* Chaudoir, of eastern Australia, is apparently a distinct but related species.

Coptodera lineolata Bates

Bates 1869, Ent. Monthly Mag. 6, p. 74.
Csiki 1932, Coleop. Cat., Carabidae, Harpalinae 7, p. 1371 (see for synonymy and additional references).
Louwerens 1956, Treubia 23, p. 225 (Moluccas).

Description. None required here; see preceding *Key* and Figure 68; length ± 5–6 mm.

Types. From **New Guinea**, "collected in numbers [presumably at Dorey] by Mr. Wallace"; presumed type now in Oberthür Coll., Paris Mus. (not seen).

Occurrence in New Guinea. Common probably throughout **New Guinea** and on Biak and Normanby Is.: 231 specimens

(including 66 from Dobodura and Oro Bay); most from low altitudes, but reaching 1200–1500 m at Wau and 1400 m at Karubaka, Swart Valley.

Notes. *C. lineolata* ranges from **Celebes** to **New Guinea** and **New Britain**, and *C. mastersi* Macleay of eastern Australia is closely related.

New Guinean specimens vary in size individually (not geographically) from *c.* 4.5 to 6.3 mm in length. The pale elytral marks vary individually and perhaps also geographically, although I cannot now define useful subspecies. Individuals from Biak Is. have the markings notably reduced, but variably so.

Coptodera eluta Andrewes

Andrewes 1923, Trans. Ent. Soc. London for 1923, p. 30.
Csiki 1932, Coleop. Cat., Carabidae, Harpalinae 7, p. 1370 (see for synonymy and additional references).
Louwerens 1956, Treubia 23, p. 225 (Moluccas).
——— 1964, Ent. Tidskrift 85, p. 181 (Borneo).
Jedlicka 1963, Ent. Abhandlungen 28, pp. 342, 349, fig. 103.
interrupta Chaudoir 1869, Ann. Soc. Ent. Belgium 12, p. 194 (not *interrupta* Schmidt-Goebel 1846).

Description. None needed here; see *Key to Species of Coptodera of New Guinea*, and following *Notes*; length ± 6.5 mm.

Types. Both Chaudoir and Andrewes had this insect from several different localities, and neither designated a type. Its selection should await careful study of specimens from all pertinent localities, for the species is variable, perhaps polytypic (Jedlicka, 1963), and often misidentified.

Occurrence in New Guinea. Twenty-six specimens from numerous localities in all 3 political divisions of **New Guinea**; most at low altitudes, but one at 1200–1300 m at Wau.

Notes. This species apparently ranges from **SE. Asia** to the **Philippines**, **New Guinea**, and **New Britain**. Most New Guinean individuals have the elytra slightly flecked with pale, but some are almost unmarked. These resemble *C. oxyptera* in dark color and acute sutural angles but differ strikingly in narrower form, deep elytral striae, 3rd intervals 4-punctate, and ♂ middle tibiae with only 1 subapical excision.

Coptodera oxyptera Chaudoir

Chaudoir 1869, Ann. Soc. Ent. Belgium 12, p. 175.
Csiki 1932, Coleop. Cat., Carabidae, Harpalinae 7, p. 1371 (see for additional references).
Louwerens 1956, Treubia 23, p. 225 (Moluccas).

Description (for recognition only). Form broad; color black, not marked; prothorax usually with a few short fine setae on margins near apical angles; elytra with sutural angles acute or acutely denticulate but not spined; 3rd intervals with only subbasal and subapical seta-bearing punctures; ♂ front but not middle tarsi squamulose, and ♂ middle tibiae each with 2 small excisions on inner edge near apex; length *c.* 5.5–7.0 mm.

Type. From **Celebes** (Wallace), now in Oberthür Coll., Paris Mus. (not seen).

Occurrence in New Guinea. Common probably throughout **New Guinea**: 145 specimens (including 77 from Dobodura); most at low altitudes but reaching at least 1300 m at Wau and 1200 at Rattan Camp, Snow Mts.

Notes. I have not seen specimens from Celebes, but Chaudoir's description fits the present species, specifying (partly by reference to his description of *testrastigma*) pointed-denticulate but not spined elytral apices and presence of only subbasal and subapical punctures of the 3rd elytral intervals. For comparison with *eluta*, see *Notes* under that species, above. *C. oxyptera*, as I identify it, occurs on **Celebes**, the **Moluccas**, **New Guinea**, **New Britain**, and **New Ireland**. It is not represented in Australia.

Coptodera papuella n. sp.

Description. With characters of genus; form (Fig. 69) *c.* as in *wau* (below), *Coptodera*-like but with prothorax lobed or subpedunculate at base; dull green, margins and much of base and apex of prothorax and margins and markings of

elytra testaceous, the elytral markings being 2 transverse series of longitudinal lines of varying length on the intervals, appendages irregularly testaceous; entire upper surface with close, heavily impressed, reticulate microsculpture *c.* isodiametric on head and disc of pronotum, scarcely transverse even on elytra. *Head* 0.82 and 0.81 width prothorax; mandibles rather short (in genus); labrum usually weakly emarginate at apex. *Prothorax* wide-subcordate; width/length 1.71 and 1.68; base/apex 1.14 and 1.19; base lobed, subpedunculate; base and apex not margined at middle; disc with usual impressions and also impressed each side. *Elytra* wide; width elytra/prothorax 1.70 and 1.68; apices obliquely sinuate-truncate with outer and sutural angles rounded; striae impressed, not distinctly punctulate; intervals moderately convex, 3rd 4-punctate as described for genus. *Secondary sexual characters*: ♂ front tarsi very narrowly squamulose, middle tarsi not squamulose; ♂ middle tibiae with 1 small excision or impression on inner edge near apex; 2 setae each side last ventral segment in both sexes. *Measurements*: length 3.5–3.9; width 1.8–2.0 mm.

Types. Holotype ♂ (M.C.Z., Type No. 31,415) and 4 paratypes from Dobodura, **Papua**, Mar.–July 1944 (Darlington), and 56 additional paratypes from Oro Bay (near Dobodura), Dec. 1943–Jan. 1944 (Darlington).

Additional material. Forty-five, from numerous localities in all 3 political divisions of **New Guinea**; most at low altitudes but up to 1150 m at Wau. Because the type series is adequate, because I expect to distribute paratypes to all museums concerned, and because some geographic variation (of markings) seems to occur, I have restricted the type series to specimens from Dobodura and Oro Bay.

Measured specimens. The ♂ holotype and 1 ♀ paratype from Dobodura.

Notes. This species resembles the Australian *Ectinochila aurata* (Macleay) in small size and dull, heavily microreticulate surface. The basal lobe of the prothorax is intermediate between the usual (lobeless) condition in *Coptodera* and the very strong lobe in *E. aurata*. In this and in some other characters (see *Notes* under *Coptodera*) the present new species and the following one (*wau*) connect *Coptodera* and *Ectinochila* and (I think) justify reducing *Ectinochila* to synonymy.

Coptodera papuella is common on trunks and large branches of standing and recently fallen trees in rain forest.

Coptodera wau n. sp.

Description. With characters of genus and (except as follows) of preceding species (*papuella*); form as in Figure 70; color *c.* as in *papuella* except pale marks of elytra fused to form a broad X, with anterior arms of X extending (narrowly) to humeri and posterior arms more or less connected across suture. *Head* 0.82 and 0.83 width prothorax; front longitudinally rugose anteriorly especially at sides, more irregularly rugose posteriorly. *Prothorax*: width length 1.69 and 1.70; base apex 1.26 and 1.19; disc impressed each side (as in *papuella*), with an area before middle relatively shining and transversely microreticulate. *Elytra*: width elytra prothorax 1.65 and 1.67; elytra slightly humped near base, the raised area relatively shining and with confused microsculpture, and other dark areas of elytra slightly more shining than pale areas. *Measurements*: length 4.4–4.8; width 2.0–2.3 mm.

Types. Holotype ♂ (Bishop Mus.) and 12 paratypes (some in M.C.Z., Type No. 31,416) from Wau, Morobe Dist., **N-E. N. G.**, altitudes from 1200 to 1500 m, dates in June, Sept., Dec., 1961–1962 (Sedlaceks), and additional paratypes as follows. **N-E. N. G.**: 1, Kainantu, 1250 m, Jan. 8, 1965 (Sedlacek); 3, Okapa, dates in Jan., June, Sept., 1964, 1965 (Hornabrook). **West N. G.**: 6, Enarotadi, Wissel Lakes, 1850–1900 m, July 28, 1962 (Sedlacek).

Measured specimens. The ♂ holotype and 1 ♀ paratype from Wau.

Notes. For distinguishing characters and place of this species among other New Guinean *Coptodera*, see *Description* above, *Notes* under the preceding species (*papuella*), and the *Key to Species of Coptodera of New Guinea.*

MINUPHLOEUS n. gen.

Diagnosis. See *Key to Genera of Lebiini of New Guinea*; Figure 71; and *Notes*, below.

Description. Form broad, depressed; some very short pubescence present above and below, the hairs longer at sides of prothorax and elytra. *Head* broad; eyes rather small but prominent; 2 setae over each eye; clypeus subtruncate, 1-setose each side; labrum subparallel, rounded at sides anteriorly, notched at middle, 6-setose; antennae short, reaching not or not much beyond base of prothorax, pubescent from apex 4th segment; mandibles ordinary; mentum strongly toothed; ligula rather narrow, 4-setose; paraglossae attached to ligula but longer, rounded, not setose; palpi slender. *Prothorax* wide-subcordate; sides of disc widely, irregularly depressed but actual margins moderate or narrow, with numerous lateral setae; basal marginal line entire, apical marginal line weak or interrupted at middle; disc with middle line well impressed, basal transverse impression very deep, anterior transverse impression almost obsolete. *Elytra*: humeri prominent but rounded, strongly margined; apices slightly obliquely sinuate-truncate, with outer angles broadly and sutural angles narrowly rounded; striae entire; intervals not elevated at base, 3rd with *c.* 4, 5th with 1 or 2 (near base), 7th with *c.* 4 or 5 apparent special seta-bearing punctures variable in position and difficult to identify among other punctures. *Inner wings* full. *Legs*: tarsi sparsely pilose above; 4th hind-tarsal segment rather small, weakly emarginate; 5th segment with accessory setae; claws with *c.* 5 or 6 small teeth. *Secondary sexual characters*: ♂ front tarsi very little dilated but with 4 segments squamulose, the squamules slender, rather numerous, not paired; ♂ middle tarsi without squamae; ♂ middle tibiae with small excision on inner edge near apex; 2 setae each side near apex last ventral segment in both sexes; ♂ copulatory organs as in Figure 177.

Type species. Minuphloeus mixtus, below.

Generic distribution. That of the single known species, below.

Notes. This insect differs from *Minuthodes* in form; the labrum is notched (not notched in *Minuthodes*); and the lateral pronotal setae are more numerous. It looks a little like some *Philophloeus* (an Australian genus unknown in New Guinea), but the antennal pubescence is different (antennae pubescent from middle of 3rd segments in *Philophloeus*, from apex of 4th in *Minuphloeus*); the labrum is different (not notched in *Philophloeus*); etc. It slightly resembles some *Coptodera*, but the mentum is toothed (not in *Coptodera*), and the ligula is 4-setose (2-setose in *Coptodera*). *Minuphloeus* even resembles some wide, depressed *Catascopus*, but the toothed claws, excised ♂ middle tibiae, and other characters differentiate it from that genus. I am therefore forced to treat the insect as a new monotypic genus, exact relationships undetermined, occurring (so far as known) only in a small area in New Guinea.

The name of the new genus is formed by combining the first two syllables of *Minuthodes* with the last two of *Philophloeus.*

Minuphloeus mixtus n. sp.

Description. With characters of genus; form as in Figure 71; black, shining, most of upper surface without reticulate microsculpture but extensively punctate. *Head* 0.84 and 0.83 width prothorax; front irregularly impressed, irregularly punctate, with short longitudinal ridge each side inside position of anterior supraocular setae. *Prothorax*: width/length 1.82 and 1.80;

base/apex 1.04 and 1.04; margins with numerous strong setae irregularly spaced in whole length; disc finely, sparsely, irregularly punctate. *Elytra*: width elytra/prothorax 1.51 and 1.55; striae moderately impressed, closely punctate; intervals slightly convex, sparsely punctate. *Measurements*: length *c.* 7.0–8.5; width *c.* 3.3–4.0 mm.

Types. Holotype ♂ (Bishop Mus.) and 32 paratypes (some in M.C.Z., Type No. 31,417) from Wau (including Mt. Missim, Kunai Ck., Mt. Kaindi), Morobe Dist., **N-E. N. G.,** 900, 1200, 1300, 1400, 1500, 1500–1800, 1600–2000 m, dates in Jan., Feb., May, June, July, Aug., Sept., Nov., Dec., 1961–1964 (Sedlaceks), and additional paratypes as follows. **N-E. N. G.**: 1, Moife, 15 km NW. of Okapa, 2100 m Oct. 11–13, 1959 (T. C. Maa, Bishop Mus.); 8, Okapa, dates in Apr., Aug., Oct., 1964, Mar. 1965 (Hornabrook). **West N. G.**: 19, Enarotadi, Wissel Lakes, 1800, 1800–1900, 1850–1950 m, dates from July 19 to Aug. 4, 1962 (Sedlacek).

Measured specimens. The ♂ holotype and 1 ♀ paratype from Wau.

Notes. See *Notes* under genus. The insect looks as if it lived on tree trunks or under bark, but its actual habitat is not recorded.

Genus AGONOCHILA Chaudoir

Chaudoir 1848, Bull. Soc. Nat. Moscow 21, Part 1, p. 119.

——— 1869, Ann. Soc. Ent. Belgium 12, p. 223.

Csiki 1932, Coleop. Cat., Carabidae, Harpalinae 7, p. 1379 (see for additional references and list of species).

Sloane 1898, Proc. Linnean Soc. New South Wales 23, p. 494 (in key to Australian genera of Lebiini).

Diagnosis. See *Key to Genera of Lebiini of New Guinea.*

Description: characters common to the New Guinean species of the genus (Australian species are more diverse). Form as in Figures 72–76; small, broad, ± convex; short-pubescent above and below, and part or all of upper surface also closely punctate or (at least elytra) roughened. *Head*: eyes prominent but not large; 2 setae over each eye; clypeus subtruncate, 1-setose each side; labrum broadly rounded or subtruncate, 6-setose; mentum toothed; ligula with 2 long and usually 2 short setae, paraglossae *c.* as long as or slightly longer than and attached to ligula; palpi, especially penultimate segments, short. *Prothorax* variable in form (see Figs. cited); base ± arcuate at middle but not strongly lobed; lateral margins narrow to wide, each with seta at base and at (usually) or slightly before middle of length; base and apex with lightly impressed marginal lines sometimes faint or interrupted at middle; disc with moderate middle line and transverse impressions. *Elytra*: humeri moderately prominent, rounded; apices obliquely sinuate-truncate, with outer angles broadly and sutural angles narrowly rounded or blunted; striae entire or nearly so but usually lightly impressed, not sharply defined; 3rd intervals apparently usually 3- or 4-punctate, but dorsal punctures difficult to identify amid other punctation and pubescence. *Inner wings* full. *Legs* slender; 4th tarsal segments weakly emarginate; 5th segments with accessory setae; claws with *c.* 4 short teeth. *Secondary sexual characters*: ♂ front tarsi slightly dilated, soles formed of many squamae *not* arranged in 2 series (in all species of which ♂ ♂ in satisfactory condition are available); ♂ middle tibiae with small notch or impression on inner edge just before apex (except in *expansa*); 2 setae each side last ventral segment in both sexes.

Type species. A. guttata Chaudoir, of southern Australia (only species mentioned by Chaudoir in 1848).

Generic distribution. Many species in **Australia**; 1 Australian species also (introduced?) in **New Zealand**; 7 small species in **New Guinea**, chiefly in lower mountains.

Notes. The 7 New Guinean species that I assign to this genus differ among themselves, but they all seem to belong to one small group of the genus that may be

restricted to New Guinea and the adjacent tropical part of Australia. Described Australian species of the group probably include *Agonochila ovalis* Sloane and *intricata* Sloane (both described 1923, Proc. Linnean Soc. New South Wales 48, p. 39), and I have specimens representing one or more forms of this group from North Queensland, Australia, from rain forest on and near the Atherton Tableland. This group of small, pubescent species, with notched ♂ middle tibiae, *may* prove to be worth generic separation from *Agonochila*, but the Australian *Agonochila* need much more study before division of the genus is undertaken.

Most Australian *Agonochila* live on tree trunks, especially on shaggy-trunked *Eucalyptus* trees. The habitat of the New Guinean ones is not recorded but is probably in rain forest.

Key to Species of *Agonochila* of New Guinea

1. Elytra with pattern of many pale longitudinal dashes in 3 irregular transverse series which cover nearly the whole elytra (Fig. 72) 2
– Elytra differently marked or not marked 3
2. Prothorax not depressed at sides (p. 119) ..... *minuthoides*
– Prothorax depressed at sides (p. 119) ..... *duplicata*
3. Prothorax not subcordate; anterior prothoracic angles broadly rounded-in 4
– Prothorax broadly subcordate 6
4. Elytra dark with single *c.* regular, common, red or testaceous area behind middle (p. 120) ..... *gressitti*
– Elytra not marked as described 5
5. Elytra with markings varying from isolated pale flecks to irregular X-pattern (Figs. 74, A, B) (p. 120) ..... *variabilis*
– Color entirely red, without elytral markings (p. 120) ..... *rufa*
6. Elytra with 2 irregular transverse pale fasciae behind middle (Fig. 75) or with markings expanded (Fig. 75A); length 5.3–5.7 mm (p. 121) ..... *expansa*
– Elytra with a large common pale area (Fig. 76) or single broad post-median fascia; length 6.0–6.7 mm (p. 121) ..... *dorsata*

Agonochila minuthoides n. sp.

Description. With characters of genus; form as in Figure 72; irregular dark reddish brown, elytra with complex pattern of short pale lines in 3 irregular transverse series, appendages testaceous; most of upper surface irregularly punctate or roughened but surface of head and pronotum shining between punctures. *Head* 0.81 and 0.80 width prothorax. *Prothorax* transverse-quadrate; width/length 1.57 and 1.53; base/apex 1.28 and 1.28; side margins very narrow, with no flattened areas inside margins. *Elytra*: width elytra/prothorax 1.64 and 1.66. *Measurements*: length 4.3–4.8; width 2.2–2.4 mm.

Types. Holotype ♂ (M.C.Z., Type No. 31,418) from Didiman Ck., Lae, **N-E. N. G.,** Mar. 27, 1955 (E. O. Wilson), in lowland rain forest; 1 ♂ paratype, Busu R., E. of Lae, 100 m, Sept. 14, 1955 (Gressitt); and 1 ♀ paratype, Sattelberg, Huon Gulf, **N-E. N. G.,** 1899 (Biró).

Measured specimens. The ♂ holotype and ♀ paratype.

Notes. The color pattern and very narrow prothoracic margins distinguish this species. The 3 known specimens are all from a rather small area in northern N-E. N. G., but it would be unsafe to assume that the species is really so localized.

The complex color pattern of this small lebiine is so like that of some *Minuthodes* and of *Coptodera lineolata* as to suggest mimetic convergence.

Agonochila duplicata n. sp.

Description. With characters of genus; form as in Figure 73; irregular dark reddish brown, elytra with complex pattern of short pale lines in 3 irregular transverse series (much as in preceding species, *minuthoides*); appendages testaceous; much of upper surface irregularly punctate, but surface shining between punctures. *Head* 0.71 width prothorax. *Prothorax* wide; width/length 1.77; base/apex 1.25; margins broadly depressed. *Elytra*: width elytra/prothorax 1.50. *Measurements*: length *c.* 4.5; width 2.2 mm.

Type. Holotype ♂ (Hungarian National

Mus.) from Sattelberg, Huon Gulf, **N-E. N. G.,** 1899 (Biró); the type is unique.

Notes. Although the individual described above is colored much like the preceding species (*minuthoides*) and occurs within the range of the latter, I think it is distinct. The wider prothoracic margins are striking, and the greater width they give the prothorax is reflected in the proportions, the head being relatively smaller, the prothorax wider, and elytra relatively narrower in *duplicata* than in *minuthoides.*

Agonochila gressitti n. sp.

Description. With characters of genus; form slender; head and prothorax red or reddish brown, elytra slightly darker (often nearly black) with large, common, red or testaceous area behind middle varying in size and shape but always with relatively regular margin (compared with some following species); appendages testaceous; most of upper surface punctate but moderately shining between punctures. *Head* 0.65 and 0.68 width prothorax. *Prothorax*: width/length 1.72 and 1.76; base/apex not calculated (anterior angles too rounded-in for exact measurement of apex); sides arcuate through most of length, sometimes faintly subangulate at median-lateral setae; posterior angles obtuse, slightly blunted; margins moderate. *Elytra*: width elytra/prothorax 1.53 and 1.62. *Measurements*: length 4.2–5.5; width 2.1–2.7 mm.

Types. Holotype ♂ (Bishop Mus.) and 5 paratypes (2 in M.C.Z., Type No. 31,419) all from Swart Vy., Karubaka, **N-E. N. G.,** 1500–1550 m, dates in Nov. 1958 (Gressitt).

Additional material. **N-E. N. G.**: 2, Adalbert Mts., Wanuma, 800–1000 m, Oct. 26, 27, 1958 (Gressitt, 1 specimen bearing his number 3222); 1, Wum, Upper Jimmi Vy., 840 m, July 16, 1955 (Gressitt).

Measured specimens. The ♂ holotype and 1 ♀ paratype.

Notes. The form plus coloration of this species are diagnostic, in New Guinea. The specimens listed under *Additional material* are slightly smaller and less sharply bicolored than the types but seem to be conspecific.

Agonochila rufa n. sp.

Description. With characters of genus; form *c.* as in *variabilis* (following species); entirely rufous, not marked; most of upper surface moderately punctate but head and pronotum shining between punctures, elytra duller; appendages testaceous. *Head* 0.71 and 0.69 width prothorax. *Prothorax*: width/length 1.64 and 1.65; base/apex not calculated (anterior angles rounded-in); sides faintly angulate at median-lateral setae, slightly sinuate before *c.* right (slightly obtuse) basal angles; margins rather narrow. *Elytra*: width elytra/prothorax 1.66 and 1.63. *Measurements*: length *c.* 4.0–4.5; width 2.1–2.3 mm.

Types. Holotype ♀ (Bishop Mus.) from Bisianumu, E. of Port Moresby, Papua, 500 m, Sept. 22, 1955 (Gressitt); and paratypes as follows. **Papua**: 2 ♀ ♀ (1 in M.C.Z., Type No. 31,420), Kokoda-Pitoki, 450 m, Mar. 23, 24, 1956 (Gressitt); 1 ♂, Keparra-Sangi, nr. Kokoda, 500 m, Mar. 26, 1956 (Gressitt), "Sago palm." **N-E. N. G.**: 1, Wareo, Finschhafen (L. Wagner, S. Australian Mus.).

Measured specimens. The ♀ holotype and 1 ♀ paratype from Kokoda-Pitoki.

Notes. The plain rufous color is diagnostic for this species in this genus in New Guinea.

Agonochila variabilis n. sp.

Description. With characters of genus; form as in Figure 74; irregularly brownish black with variable elytral markings pale (Figs. 74, A, B); appendages brownish testaceous; most of upper surface punctate but shining between punctures, elytra slightly less shining. *Head* 0.70 and 0.71 width prothorax. *Prothorax*: width/length 1.62 and 1.67; base apex not calculated (anterior angles rounded-in); margins moderate. *Elytra*: width elytra/prothorax 1.58 and 1.63. *Measurements*: length *c.* 4.0–4.5; width 2.1–2.3 mm.

Types. Holotype ♂ (Bishop Mus.) and 13 paratypes (some in M.C.Z., Type No. 31,421) all from Wissel Lakes, **West N. G.,** with following additional details: holotype and 1 ♀ paratype, Urapura, Kamo Vy., 1530 m, Aug. 11, 15, 1955 (Gressitt); 1 paratype, Wagete, Tigi L., 1700 m, Aug. 17, 1955 (Gressitt); 10 paratypes, Enarotadi, altitudes from 1750 to 1900 m, dates in Aug. 1955 (Gressitt) and July, Aug. 1962 (Sedlacek); 1, Moanemani, Kamo V., 1500 m, Aug. 13, 1962 (Sedlacek).

Additional material. **Papua**: 2, Mafulu, 4000 ft. (*c.* 1230 m), Jan. 1934 (Cheesman). **N-E. N. G.**: 24, Wau, Morobe Dist., altitudes from 1100 to 1450 m, dates in all months *except* Apr., June, Nov., 1961–1963 (Sedlacek); 1, Mt. Mis(s)im, Morobe Dist., 5850 ft. (*c.* 1780 m), Apr. (Stevens, M.C.Z.).

Measured specimens. The ♂ holotype and ♀ paratype from Urapura.

Notes. The specimens from Wissel Lakes vary surprisingly in elytral pattern (Figs. cited). Of the 2 from Mafulu, 1 has markings comparable to those of the most heavily marked Wissel Lakes individual, and the other is even more heavily marked. The Wau and Mt. Mis(s)im individuals are heavily marked (Fig. 74B) but somewhat variable. The variation is obviously partly individual, but heavy markings are apparently commoner in eastern than in western New Guinea.

Agonochila expansa n. sp.

Description. With characters of genus except as noted below; form (Fig. 75) broad, with wide-subcordate prothorax; black, elytra with 2 irregular, interrupted pale fasciae behind middle, the posterior one narrower and more interrupted, the fasciae sometimes partly joined and extended anteriorly on each elytron (Fig. 75A); appendages irregularly blackish brown; entire upper surface punctate but moderately shining between punctures, and head also obliquely-longitudinally rugulose at sides between eyes. *Head* 0.76 and 0.76 width prothorax. *Prothorax*: width/length 1.89 and 1.80; base/apex 1.18 and 1.18; side margins broadly depressed, with median-lateral setae before middle of prothoracic length. *Elytra*: width elytra/prothorax 1.52 and 1.59. *Secondary sexual characters* as for genus except ♂ middle tibiae not excised or impressed near apex. *Measurements*: length 5.3–5.7; width 2.5–2.8 mm.

Types. Holotype ♀ (Bishop Mus.) from Finisterre Rge., Saidor, Kiambavi Village, **N-E. N. G.,** Aug. 1–28, 1959 (W. W. Brandt), and paratypes as follows. **N-E. N. G.**: 1 ♂ in poor condition (M.C.Z., Type No. 31,422), Wau, Morobe Dist., 1400–1500 m, Dec. 20, 1961 (Sedlacek); 6, Okapa, Mar. 23, Apr. 4, 1964 (Hornabrook); 1 ♂ (with expanded markings), 11 km S. of Mt. Hagen (town), **N-E. N. G.,** 2000–2300 m, May 20, 1963 (Sedlacek).

Measured specimens. The ♂ paratype from Wau and the ♀ holotype.

Notes. In form and markings this species looks more like a *Coptodera* than an *Agonochila*, but it has the characters of the latter genus, as here defined. The middle tibiae lack excisions in both ♂ ♂ listed, but this is probably a specific (not generic) character, for the following species (*dorsata*), which seems close in most ways to the present one, has the notch present, but weak.

Agonochila dorsata n. sp.

Description. With characters of genus; form as in Figure 76; black or irregularly reddish black, elytra either with large testaceous area as figured or the pale area reduced to a *single* transverse post-median fascia; entire upper surface closely punctate, but ± shining between punctures. *Head* 0.82 and 0.82 width prothorax; front especially at sides slightly rugulose as well as punctate. *Prothorax* broadly cordate; width/length 1.84 and 1.80; base/apex 1.13 and 1.15; sides broadly depressed, with median-lateral seta slightly before middle. *Elytra*: width elytra/prothorax 1.58 and 1.65; sutural angles better defined than

usual, scarcely blunted. *Secondary sexual characters* as for genus, including ♂ middle tibiae impressed on inner edge near apex. *Measurements*: length 6.0–6.7; width 2.9–3.3 mm.

Types. Holotype ♂ (Bishop Mus.) and 11 paratypes (some in M.C.Z., Type No. 31,423) from Kepilam, **N-E. N. G.,** 2420–2540 m, June 21 and 23, 1963 (Sedlacek).

Additional material. **N-E. N. G.**: 3, 11 km S. of Mt. Hagen (town), 2000–2300 m, May 20, 1963 (Sedlacek); 1, Edie Ck., Morobe Dist., 2000–2100 m, Oct. 5–10, 1963 (Sedlaceks); 1, Kainantu, 2150 m, Jan. 8, 1965 (Sedlacek).

Measured specimens. The ♂ holotype and 1 ♀ paratype.

Notes. This is the largest *Agonochila* in New Guinea, and it occurs at relatively high altitudes. The form plus markings are diagnostic. The testaceous area of the elytra varies geographically: it is large (*c.* as in Fig. 76) in the whole type series, but reduced to a (broad) transverse fascia (Fig. 76A) in all specimens listed under *Additional material.* However, I do not wish to make subspecies without seeing more material from more localities.

Genus *OXYODONTUS* Chaudoir

Chaudoir 1869, Ann. Soc. Ent. Belgium 12, p. 239.

Diagnosis. See *Key to Genera of Lebiini of New Guinea*; note especially form, small size, long acute mentum tooth, rounded-oblique elytral apices, and plainly 3-punctate 3rd elytral intervals.

Description. Form as in Figure 77; part of surface including pronotum and sides of elytra *very inconspicuously* setulose. *Head*: eyes prominent, 2 setae over each eye; labrum ± rounded, 6-setose; mentum with long, acute tooth; ligula narrow, with 2 long and 2 shorter setae; paraglossae *c.* long as ligula, attached, wide, without setae. *Prothorax* with usual 2 setae each side. *Elytra* formed as figured; apices rounded-oblique; striae entire, moderately impressed; 3rd intervals strongly 3-punctate, with punctures *c.* ¼ from base on outer edge, and near middle and apex on inner edge. *Inner wings* full. *Legs* slender; 4th tarsal segments small, weakly emarginate; 5th segments with accessory setae; claws with *c.* 3 teeth. *Secondary sexual characters*: ♂ front tarsi slightly dilated, 3 segments with narrow squamae *not* in 2 regular series; ♂ middle tibiae with minute but deep excision on inner edge just before apex; ♂ with 1, ♀ 2 setae each side near apex last ventral segment.

Type species. O. tripunctatus Chaudoir (below).

Generic distribution. That of the single species.

Notes. The relationships of this inconspicuous genus are not clear.

Oxyodontus tripunctatus Chaudoir

Chaudoir 1869, Ann. Soc. Ent. Belgium 12, p. 239. Louwerens 1956, Treubia 23, p. 226 (Moluccas).

Description. None required here. See under genus, of which this is the only known species, and see Figure 77; length *c.* 4–4.5 mm.

Types. Two specimens from **Celebes**, collected by Wallace; type now in Oberthür Coll., Paris Mus. (not seen).

Occurrence in New Guinea. Common probably throughout **New Guinea**: 78 specimens (including 53 from Dobodura), from localities in all 3 political divisions of New Guinea; chiefly at low altitudes, but to 1300 m at Wau.

Notes. This species has been previously recorded from **Celebes** and the **Moluccas**, and I have a series of it (or of a closely related species) also from Leyte and Luzon in the **Philippines**. It is not known in New Britain or Australia. I think it lives in understory foliage in rain forest, but my scanty field notes are not clear about this.

Genus *MOCHTHERUS* Schmidt-Goebel

Schmidt-Goebel 1846, Faunula Coleop. Birmaniae, p. 76.

Csiki 1932, Coleop. Cat., Carabidae, Harpalinae 7,

p. 1382 (see for additional references, synonymy, and list of species).
Jedlicka 1963, Ent. Abhandlungen 28, p. 352.

Diagnosis. See *Key to Genera of Lebiini of New Guinea*; and note form (Fig. 78), unarmed elytral apices, and minutely setulose pronotal disc.

Description. Form *c.* as in Figure 78. *Head*: eyes large; 2 setae over each eye; labrum subtruncate, not emarginate, 6-setose; mentum weakly, usually obtusely (variably?) toothed; ligula and paraglossae subequal, attached, together wide, 4-setose; palpi slender. *Prothorax* cordate, with usual 2 setae each side. *Elytra* wide, unarmed; apices slightly obliquely sinuate-truncate; 3rd intervals 2-punctate, the punctures on inner edge behind middle and near apex. *Inner wings* full. *Legs* slender; 4th tarsal segments small, scarcely emarginate; 5th segments with (weak) accessory setae; claws each with 2 long and 1 shorter tooth. *Secondary sexual characters*: ♂ front tarsi scarcely dilated, 3 segments with paired squamae; ♂ middle tibiae not excised; ♂ with 1, ♀ 2 setae near apex each side last ventral segment.

Type species. M. angulatus Schmidt-Goebel (= *tetraspilotus* Macleay) of SE. Asia, etc.

Generic distribution. **SE. Asia** including **Japan**, and across the **Malay Archipelago** to the **Philippines** and **New Guinea** (not Australia), with one species recorded (introduced?) also on **Christmas Is.** and **Samoa**.

Notes. A single common species of the genus occurs on New Guinea.

Mochtherus obscurus (Sloane)

Sloane 1907, Deutsche Ent. Zeitschrift for 1907, p. 183 (?*Sinurus*).
Andrewes 1927, Ann. Mag. Nat. Hist. (9) 19, p. 110.
immaculatus Maindron (not Redtenbacher) 1908, Nova Guinea 5, p. 299.

Description (for recognition only). With characters of genus; form as in Figure 78; dull black, surface minutely short-setulose; length *c.* 6–7 mm.

Type. From Sattelberg, **N-E. N. G.**; should be in Deutsches Entomologisches Institut, Berlin-Dahlem (seen by Andrewes).

Occurrence in New Guinea. Common probably throughout **New Guinea** (130 specimens, including 79 from Dobodura), most at low altitudes, but reaching 1200 m at Wau (only 1 specimen at this altitude) and 1530 m on the Salawaket Rge. (2 specimens). Found also on Normanby Is. (2 specimens) and Waigeu Is. (1).

Notes. This species occurs also on **New Britain** (6 specimens including 3 from Gazelle Pen.) and **New Ireland** (3).

The relationship of the New Guinean *obscurus* to *asemus* Andrewes (recorded from the Moluccas by Louwerens 1956, Treubia 23, p. 226) and to other species farther west in the Malay Archipelago remains to be determined. In general the "species" seem very closely inter-allied in this genus, and some may prove to be geographic subspecies.

This insect lives on and under the bark of tree trunks and recently fallen logs in rain forest.

(Genus *MOCHTHEROIDES* Andrewes)

Andrewes 1923, Trans. Ent. Soc. London for 1923, p. 50.
Jedlicka 1963, Ent. Abhandlungen 28, p. 352.

Diagnosis. See *Key to Genera of Lebiini of New Guinea.*

Description. Form *c.* as in Figure 79. *Head*: eyes moderate; 2 setae over each eye; mandibles moderate; labrum rounded-truncate, not (or scarcely) emarginate, 6-setose; mentum obtusely prominent at middle but scarcely toothed; ligula wide, 4-setose, with paraglossae not attached (except at base), longer and narrower than ligula. *Prothorax* subcordate, with very narrow margins, each with usual 2 setae. *Elytra* with apices obliquely sinuate-truncate, unarmed; striae entire; 3rd intervals with 1 seta-bearing puncture on inner edge at extreme apex but otherwise impunctate.

Legs slender; 4th tarsal segments emarginate for less than half of length; 5th segments with accessory setae; claws each with *c.* 4 very small teeth. *Inner wings* full. *Secondary sexual characters*: ♂ front tarsi wider than in *Mochtherus*, with 3 segments 2-seriately squamulose; ♂ middle tibiae not excised; ♂ with 1, ♀ with 2 setae near apex each side last ventral segment.

Type species. *Masoreus sericans* Schmidt-Goebel, of Burma, etc.

Generic distribution. Known from **Burma**, **Singapore**, **Sumatra**, **Philippines**, and **New Britain**; not recorded from New Guinea, but may occur there.

Notes. *Mochtheroides* superficially resembles *Mochtherus* but the two genera are probably not related. They differ in mouthparts, punctures of 3rd elytral intervals, claw teeth, etc.

(*Mochtheroides niger* Jedlicka)

Jedlicka 1934, Acta Soc. Ent. Prague 31, p. 122.
——— 1963, Ent. Abhandlungen 28, p. 352.

Description (for recognition only). With characters of genus; form as in Figure 79; black, most of surface (except prosternum) not setulose. *Prothorax* with margins very narrow. *Elytra* with 3rd intervals with only 1 (apical) seta-bearing puncture; length *c.* 4.5–4.8 mm.

Type. From Sibuyan Is., **Philippines**; in Andrewes Coll., British Mus. (seen).

Occurrence in New Guinea. Not yet found, but may occur.

Notes. Three specimens that I collected at Cape Gloucester, **New Britain** (under the bark of a small dead tree) seem indistinguishable from the Philippine type, with which I compared them in 1948. This distribution suggests that the species will be found in New Guinea too.

Genus *DOLICHOCTIS* Schmidt-Goebel

Schmidt-Goebel 1846, Faunula Coleop. Birmaniae, p. 62.
Andrewes 1931, Zool. Mededelingen 14, pp. 62–64 (key to Sumatran species).
Csiki 1932, Coleop. Cat., Carabidae, Harpalinae 7, p. 1383 (see for additional references and list of species).
Louwerens 1958, Treubia 24, pp. 258, 259 (comments on some species).
Jedlicka 1963, Ent. Abhandlungen 28, p. 356.

Diagnosis. Small Lebiini, rather diverse in form; not pubescent; mentum without tooth; ligula and paraglossae fused into a broadly rounded whole, with usually 2 principal and several slightly smaller setae; each 3rd elytral interval usually with 2 minute punctures behind middle, these punctures without setae.

Description. Form variable (Figs. 80–85); not pubescent above, with or without reticulate microsculpture, latter (if present) *c.* isodiametric on front, transverse on pronotum, more transverse on elytra. *Head*: eyes moderately prominent (abruptly so in *distorta*), with 2 seta-bearing punctures over each eye except anterior puncture absent in *distorta* and reduced in *aculeata* group to a small impressed puncture without seta; clypeus *c.* truncate, 1-setose each side; labrum rather long, subtruncate or slightly arcuate at apex except slightly emarginate in *microdera*, 6-setose; mentum without tooth, at most slightly arcuately prominent at middle; ligula and maxillae fused, together broadly rounded, with usually 2 principal setae slightly before apex and additional smaller setae at apex (setae often difficult to distinguish); palpi rather short, but apical segments not widened; antennae moderate, pubescent from 5th segments, sometimes a little pubescence on apex of 4th. *Prothorax*: setae at basal angles present, median-lateral setae present or absent; base not margined at middle, apex usually with fine marginal line entire; discal impressions usually present, sometimes almost obsolete. *Elytra* varying in form and in presence or absence of apical spines; striation entire, varying in depth and in punctation; 3rd intervals usually with 2 minute punctures without setae placed irregularly in posterior half of elytral length (see *Notes*, below). *Inner wings* full. *Legs*

slender; 4th tarsal segments weakly emarginate; 5th segments with few, weak accessory setae; claws with *c.* 3 to 5 teeth. *Secondary sexual characters*: ♂ front tarsi very little dilated, 3 segments with paired squamae at least near apex; ♂ middle tarsi without squamae; ♂ middle tibiae not excised; ♂ with 1, ♀ 1 or 2 setae each side last ventral segment.

Type species. Dolichoctis striata Schmidt-Goebel (below).

Generic distribution. Numerous from **SE. Asia** across the islands to **New Guinea**, a few species reaching **New Britain**, **New Ireland**, the **Solomons**, and northern **Australia**.

Notes. The 13 New Guinean species of *Dolichoctis* can be arranged in 5 groups. *D. striata* and *microdera* represent separate species groups which are widely distributed outside New Guinea and which have probably reached New Guinea comparatively recently from the west. *D. distorta* is unique and forms a group of its own; it may be derived from either of the following species groups or from a common ancestor. Six of the remaining New Guinean species form what I call the *aculeata* group, characterized by anterior supraocular seta-bearing punctures reduced to small impressed points without setae, median-lateral pronotal setae lost, elytra dentate or spined, and reticulate microsculpture present on entire upper surface. Excepting *dentata*, which is satisfactorily distinct, the species of this group are very similar to each other and difficult to define because of occurrence of intermediates. They are sympatric —all 6 species occur at Dobodura—and do not seem to be differentiating geographically. This group is represented also outside New Guinea. Finally, 4 species form what I am naming the *polita* group, which is like the *aculeata* group in form and in spined elytra, but anterior supraocular seta-bearing punctures are present, and reticulate microsculpture is absent on head and pronotum and in some cases absent on elytra too. The species of this group differ among themselves in color, elytral microsculpture, and form of elytral striae. This group is thus far known only from the eastern half of New Guinea, and the species are partly allopatric: *divisa* and *huon* seem not to occur together, and neither do *castanea* and *polita*.

Although the New Guinean *Dolichoctis* are rather diverse, they are less so than the Oriental members of the genus. Some Oriental groups, including *Menarus* (a group of small convex species), are not represented in New Guinea at all. The general pattern of distribution of the genus suggests that 3 or 4 stocks have reached New Guinea at different times, probably all from the direction of tropical Asia, and that 1 or 2 of the older stocks have radiated moderately on the island.

The 2 minute impressed punctures, without setae, on each 3rd elytral interval posteriorly are present in most *Dolichoctis* but may be absent in *distorta* (in which these punctures, if present, are lost in the general punctation of the intervals) and are difficult to see and perhaps sometimes absent in the *polita* group. These minute punctures are best seen in carefully cleaned specimens under diffused light. When I have been able to see them clearly in the first 1 or 2 specimens of a series, I have credited that species with possessing them, without attempting to clean and examine whole series.

Although my field notes do not distinguish most species of this genus, I know that most of them (except *microdera*) are arboreal, living in understory foliage in rain forest. They are usually collected by sweeping or beating. They do not often fly to light, which suggests that they may be largely diurnal. However, one species, *distorta*, is apparently known only from light-collected specimens. It may be nocturnal and may occupy a habitat that collectors do not often reach, perhaps treetops in rain forest.

KEY TO SPECIES OF *DOLICHOCTIS* OF NEW GUINEA

1. Elytra obliquely truncate at apex, not spined or denticulate; elytra usually spotted 2
– Elytra spined or acutely denticulate at apex; not spotted, except sutural area sometimes red 3
2. Prothorax wide and widely margined (p. 126) ..... *striata*
– Prothorax narrow, narrowly margined (p. 127) ..... *microdera*
3. Head distorted, eyes small but abruptly prominent, front swollen on each side; prothorax semicircular, more than 2× wide as long (p. 127) ..... *distorta*
– Head normal; prothorax less than 2× wide as long 4
4. Head and pronotum (and elytra) with reticulate microsculpture; anterior seta-bearing punctures over eyes reduced to minute punctures without setae (*aculeata* group) 5
– Head and pronotum without reticulate microsculpture (elytra with or without it); anterior (as well as posterior) seta-bearing punctures present over eyes (*polita* group) 10
5. Form broader, more *Agonum*-like (Fig. 82); prothorax relatively smaller and narrower; elytra dentate at apex (p. 128) ..... *dentata*
– Form more oval or fusiform; prothorax usually relatively larger and wider; elytra spined at apex 6
6. Elytral striae very lightly impressed, 7th striae reduced to very fine superficial lines; elytral spines usually very long (but variable) (p. 128) ..... *spinosa*
– Elytral striae including 7th well impressed; elytral spines usually shorter 7
7. Suture or sutural area red; form usually relatively narrow; length 4.6–5.6 mm. (p. 129) ..... *suturalis*
– Suture not red; form variable; size often larger 8
8. Sides of prothorax ± strongly sinuate; elytral striae moderately impressed (p. 129) ..... *aculeata*
– Sides of prothorax not or only slightly sinuate; elytral striae often deeper 9
9. Prothorax wider (width/length 1.78 and 1.80), with sides more rounded and with wider margins (p. 130) ..... *subrotunda*
– Prothorax narrower (width/length 1.61 and 1.69), with sides less rounded and with narrower margins (p. 130) ..... *subquadrata*
10. Strikingly bicolored, head and prothorax red, elytra black or piceous; often larger (5.8–7.4 mm) 11
– Not or at most vaguely bicolored; often smaller (5.4–6.5 mm) 12
11. Elytra with grooved striae and distinct reticulate microsculpture (p. 131) ..... *divisa*
– Elytra with striae formed by rows of small punctures and elytral disc without reticulate microsculpture (p. 131) ..... *huon*
12. Elytra with reticulate microsculpture (p. 131) ..... *castanea*
– Elytral disc without reticulate microsculpture (p. 132) ..... *polita*

Dolichoctis striata Schmidt-Goebel

Schmidt-Goebel 1846, Faunula Coleop. Birmaniae, p. 62.
Csiki 1932, Coleop. Cat., Carabidae, Harpalinae 7, p. 1384 (see for synonymy and additional references).
Louwerens 1958, Treubia 24, p. 258.
Jedlicka 1963, Ent. Abhandlungen 28, p. 357.

Description (for recognition only). With characters of genus; form broad, with elytra unarmed; black or piceous, elytra usually with red spots; 2 setae over each eye; prothorax with 2 setae each side (see *Notes*, below); length *c.* 4–4.5 mm.

Type(s). From **Burma**, in Prague Mus. (not seen).

Occurrence in New Guinea. Common probably throughout **New Guinea**: 200 specimens (by count), including examples from Normanby, Woodlark, Biak, and Waigeu Is.; most at low altitudes (including Dobodura), but a few at 1050, 1100, and 1200 m at Wau.

Notes. The recorded range of *striata* is from **SE. Asia** (including **Ceylon** and **Japan**) to the **Philippines**, **New Guinea**, and North Queensland, **Australia**, and I have specimens also from **New Britain** and **New Ireland**. Whether populations from all these places are in fact conspecific is a question for future study.

Most individuals from New Guinea are either 4-spotted (each elytron with a pale spot near base and another near apex), 2-spotted (with only the subapical spots), or intermediate (with conspicuous subapical and fainter subbasal spots—note that the subbasal elytral spots vary in distinctness more than in size). The single individual

seen from Woodlark Is. is the only unspotted one in the New Guinean series. However, 4-spotted, 2-spotted, and unspotted individuals are said to occur elsewhere in the species' range (Louwerens 1958).

Of the 200 New Guinean individuals, all that are in condition to examine have 2 seta-bearing (or formerly seta-bearing) punctures over each eye, and all have both a basal and a median-lateral seta (or puncture) in each prothoracic margin except that 2 specimens from Nabire, West N. G. (Bishop Mus.), lack the median-lateral seta and puncture on one side. These specimens have the pronotum slightly unsymmetric: angulate on the side with median seta, evenly arcuate on the side without seta. Numerous other specimens from the same locality have the median seta and puncture present on both sides.

This species lives in understory foliage in rain forest.

Dolichoctis microdera Andrewes

Andrewes 1930, Ann. Mag. Nat. Hist. (10) 6, p. 665.
——— 1931, Zoologische Mededelingen 14, p. 63.
Louwerens 1956, Treubia 23, p. 226 (Moluccas).
——— 1964, Ent. Tidskrift 85, p. 184 (Borneo).

Description (for recognition only). With characters of genus; form (Fig. 80) relatively slender, with narrow, narrowly margined prothorax; black or piceous, each elytron with 2 pale spots; 2 setae over each eye; prothorax with basal but not median-lateral setae; length *c.* 4.5–5 mm.

Type. From **Sumatra**; in Andrewes Coll., British Mus. (seen).

Occurrence in New Guinea. **Papua**: 6, Dobodura, Mar.–July 1944 (Darlington). **N-E. N. G.**: 1, Nadzab, July 1944 (Darlington); 1, Torricelli Mts., Siaute, sea level, Nov. 9–17, 1958 (W. W. Brandt, Bishop Mus.).

Notes. Comparison (made in 1948) shows that New Guinean specimens differ slightly from the Sumatran type, but the latter is unique. More material from more localities is needed to show whether the differences are individual or geographic. The known range of the species now includes **Sumatra**, **Borneo**, the **Moluccas**, and **New Guinea**.

My New Guinean specimens were (I think) taken among dead leaves on wet ground, a unique habitat for members of this genus in New Guinea.

Dolichoctis distorta n. sp.

Description. With characters of genus; form as in Figure 81; irregularly reddish piceous, appendages irregularly brown; shining, dorsal reticulate microsculpture lacking but most of surface irregularly, rather finely punctate. *Head* 0.64 and 0.65 width prothorax; eyes abnormally small but abruptly prominent, with a channel over each eye running diagonally forward; posterior seta-bearing puncture high above each eye, anterior puncture absent; front strongly swollen each side of median longitudinal channel, each swollen area impressed near middle; sides of head behind eyes longitudinally multisulcate. *Prothorax* very wide; width/length 2.13 and 2.18; base/apex 1.43 and 1.40 (base measured across seta-bearing punctures); sides very broadly rounded into base, with posterior angles not defined; margins very widely depressed, slightly reflexed; posterior-lateral setae present, median-lateral setae absent; base and apex not margined; disc with median line and posterior and anterior transverse impressions. *Elytra*: width elytra/prothorax 1.16 and 1.17; outer-apical angles distinct, *c.* right or minutely acute; apices each with short spine *c.* opposite ends 2nd intervals; striae impressed, not punctate; intervals punctate, 3rd with usual 2 small punctures doubtfully distinguishable behind middle. *Secondary sexual characters* as for genus; ♂ with 1, ♀ 2 setae each side last ventral segment. *Measurements*: length 5.7–6.5; width 2.5–2.7 mm.

Types. Holotype ♀ (M.C.Z., Type No. 31,424) from Dobodura, **Papua**, Mar.–July 1944 (Darlington); 3 paratypes, Kokoda, **Papua**, Mar. 28–29, 1956 (Gressitt), taken in light trap; and 1 paratype, same locality, 1200 ft., June 1933 (Cheesman).

Measured specimens. A ♂ paratype from Kokoda (British Mus.) and the ♀ holotype.

Notes. In spite of its unique modifications, this species is clearly a *Dolichoctis*. All known specimens were probably taken at light: Gressitt's are so labeled; Miss Cheesman's specimen has the scales of Lepidoptera stuck to it; and mine was taken on a lighted window.

Dolichoctis aculeata group

Dolichoctis aculeata Chaudoir and its immediate relatives form a well defined group with the following characters in addition to characters of the genus: form usually suboval or fusiform (but broad *Agonum*-like in *dentata*); entire upper surface microreticulate; posterior seta-bearing punctures over eyes present, anterior punctures reduced to minute points without setae; prothoracic margins with seta-bearing punctures at basal angles, without median-lateral punctures; elytra with outer-apical angles well defined (except in *dentata*) and apices acutely dentate or spined *c.* opposite ends of 1st striae or 2nd intervals; last ventral segment with 1 seta each side in both sexes.

Besides *aculeata* itself (as I identify it), the following 4 closely related new species occur in New Guinea: *spinosa*, *suturalis*, *subrotunda*, and *subquadrata*. These 5 species (including *aculeata*) apparently intergrade to some extent, and their status is therefore doubtful. *D. dentata* is more distinct. The species of this group are all sympatric in New Guinea.

Although most species of the *aculeata* group are New Guinean, the group is represented west at least to Celebes (by typical *aculeata*), on New Britain, New Ireland, and the Solomons, and in North Queensland, Australia. The group is apparently not represented in the Philippines.

Dolichoctis dentata n. sp.

Description. With characters of genus and of *aculeata* group; form as in Figure 82; broad-*Agonum*-like with relatively small prothorax; brownish black, margins and legs paler brown, antennae and mouthparts testaceous. *Head* 0.82 and 0.83 width prothorax. *Prothorax* rather small, quadrate-subcordate; width/length 1.58 and 1.60; base/apex 1.23 and 1.21; side margins moderately wide and reflexed. *Elytra*: width elytra/prothorax 1.71 and 1.73; outer-apical angles rounded, apices acutely dentate; striae moderately impressed, impunctate. *Measurements*: length 6.5–7.0; width 2.8–3.1 mm.

Types. Holotype ♂ (M.C.Z., Type No. 31,425) and 21 paratypes from Dobodura, **Papua**, Mar.–July 1944 (Darlington); and 6 additional paratypes from Oro Bay (near Dobodura), Dec. 1943–Jan. 1944 (Darlington).

Additional material. **N-E. N. G.**: 1, Surprise Ck., Morobe Dist., Oct. 7 (Stevens, M.C.Z.); 1, Simbang, Huon Gulf, 1898 (Biró); 2, Torricelli Mts., Wantipi Village, Nov. 30–Dec. 8, 1958 (W. W. Brandt, Bishop Mus.). **West N. G.**: 1, Hollandia, Jan. 1945 (Malkin, U.S.N.M.); 1, Hijob, 25 m, Sept. 10, 1956 (Neth. New Guinea Exp., Leiden Mus.); 1, Wasian, Vogelkop, Sept. 1939 (Wind, M.C.Z.).

Measured specimens. The ♂ holotype and 1 ♀ paratype from Dobodura.

Notes. I know no very close relatives of this species. It is, of course, placed in relation to others in the preceding *Key to Species*.

Dolichoctis spinosa n. sp.

Description. With characters of genus and of *aculeata* group; black, appendages dark brown; microsculpture more transverse than usual on pronotum and elytra, latter slightly iridescent. *Head* 0.74 and 0.76

width prothorax. *Prothorax* transverse-cordate; width/length 1.67 and 1.64; base/apex 1.26 and 1.25; sides depressed but margins not well defined. *Elytra*: width elytra/prothorax 1.61 and 1.72; outer-apical angles well defined but obtuse, apices with long (but variable) slightly dehiscent spines; striae, especially outer ones, very lightly impressed. *Measurements* (types only); length *c.* 6.0–7.5 (including spines); width 2.6–3.2 mm.

Types. Holotype ♂ (M.C.Z., Type No. 31,426) and 9 paratypes from Dobodura, **Papua**, Mar.–July 1944 (Darlington). Additional paratypes as follows, all from **Papua**: 3, Kokoda, 1200 ft., June, Aug., Sept. 1933 (Cheesman); 1, Palmer R. at Black R., June 7–14, 1936 (Archbold Exp., A.M.N.H.).

Additional material. Eighteen from various localities in all 3 political divisions of **New Guinea**; some at low altitudes, some at 1200 (at Wau), 1300, and 2000 m.

Measured specimens. The ♂ holotype and 1 ♀ paratype from Dobodura.

Notes. Typical specimens of this new species are easily recognized by very light elytral striation and very long elytral spines, but some individuals listed under *Additional material* have shorter spines and vary toward one or another of the following species.

Dolichoctis suturalis n. sp.

Description. With characters of genus and of *aculeata* group; form *c.* as in *aculeata* (following species) but more slender, smaller; castaneous with suture or sutural area reddish, appendages brownish testaceous. *Head* 0.69 and 0.74 width prothorax. *Prothorax*: width/length 1.79 and 1.74; base/apex 1.40 and 1.39; sides broadly rounded anteriorly, slightly sinuate before somewhat obtuse, blunted posterior angles; margins rather widely depressed especially posteriorly. *Elytra* rather narrow; width elytra/prothorax 1.44 and 1.52; outer-apical angles well defined but obtuse, apices with short spines; striae moderately impressed, not distinctly punctate. *Measurements*: length *c.* 4.6–5.6; width *c.* 2.0–2.4 mm.

Types. Holotype ♂ (M.C.Z., Type No. 31,427) and 23 paratypes from Dobodura, **Papua**, Mar.–July 1944 (Darlington); and 6 paratypes from Oro Bay (near Dobodura), Dec. 1943–Jan. 1944 (Darlington).

Additional material. Thirty-one (some doubtfully identified), from numerous localities including all 3 political divisions of **New Guinea** and Normanby Is.; most from low altitudes (usually below 500 m) but 1 from Finisterre Rge. at 1200, and 1, Upper Jimmi Vy. at 1300 m.

Measured specimens. The ♂ holotype and 1 ♀ paratype from Dobodura.

Notes. In the *aculeata* group of New Guinean *Dolichoctis*, only relatively small, slender individuals have reddish sutures. This correlation of size, form, and color suggests that *suturalis* is a real species, although the distinguishing characters are slight.

Dolichoctis aculeata Chaudoir

Chaudoir 1869, Ann. Soc. Ent. Belgium 12, p. 251.
Andrewes 1930, Treubia 7, Supplement, p. 336.
Louwerens 1956, Treubia 23, p. 226 (Moluccas).

Description. With characters of genus and of *aculeata* group. *Head* 0.72 and 0.67 width prothorax. *Prothorax*: width/length 1.80 and 1.75; base/apex 1.30 and 1.42 (proportions notably variable); sides rather broadly depressed. *Elytra*: width elytra/prothorax 1.50 and 1.49; outer-apical angles well defined, almost right (slightly obtuse), apices spined; striae moderately impressed. *Measurements*: length *c.* 5.0–6.5; width *c.* 2.2–3.0 mm.

Types. From **Celebes**, collected by Wallace; type now in Oberthür Coll., Paris Mus. (not seen).

Occurrence in New Guinea. Common probably throughout the island: 120 specimens (including 65 from Dobodura and Oro Bay), from all 3 political divisions of

New Guinea and Rossel and Woodlark Is.; most at low altitudes but reaching 1200 to 1400 m at some localities.

Measured specimens. A pair (♂ ♀) from Dobodura.

Notes. My identification of this species is based on comparison with specimens identified by Andrewes in his collection.

I collected specimens that I refer to this species at Iron Range and Rocky R. in the mid-peninsular rain forest of Cape York, **Australia**, in 1958.

Dolichoctis subrotunda n. sp.

Description. With characters of genus and of *aculeata* group; similar to *aculeata*, differing principally in form of prothorax (Fig. 83), with broadly rounded sides not or scarcely sinuate posteriorly. *Head* 0.65 and 0.66 width prothorax. *Prothorax*: width/length 1.78 and 1.80; base/apex 1.42 and 1.33; sides flattened but not strongly reflexed. *Elytra*: width elytra/prothorax 1.49 and 1.49; apical spines moderate; striae moderately impressed. *Measurements* (types): length *c.* 5.0–6.5; width *c.* 2.3–2.9 mm.

Types. Holotype ♂ (M.C.Z., Type No. 31,428) and 26 paratypes from Dobodura, **Papua**, Mar.–July 1944 (Darlington); and 2 additional paratypes from Oro Bay (near Dobodura), Dec. 1943–Jan. 1944 (Darlington).

Additional material. Sixty (some doubtfully identified) from numerous localities in all 3 political divisions of **New Guinea** and Normanby and Woodlark Is.; most at low altitudes, but recorded above 1000 m at several localities including Wau and at 2500 m in the Chimbu area.

Measured specimens. The ♂ holotype and 1 ♀ paratype from Dobodura.

Notes. Individuals assigned to this species vary considerably in size, depth of elytral striae, etc. A single specimen from **Waigeu Is.** (Camp Nok, 2500 ft. (*c.* 770 m), Apr. 1938, Cheesman) differs from all specimens from the mainland of New Guinea in having a poorly defined subapical red spot on each elytron near suture.

Dolichoctis subquadrata n. sp.

Description. With characters of genus and of *aculeata* group; form similar to *aculeata* except prothorax smaller and subquadrate (Fig. 84). *Head* 0.75 and 0.70 width prothorax. *Prothorax*: width/length 1.61 and 1.69; base/apex 1.36 and 1.44; sides usually slightly sinuate near base; margins scarcely depressed anteriorly, more broadly so posteriorly. *Elytra*: width elytra/prothorax 1.60 and 1.54; apices with moderate spines; striae usually deeply impressed (deeper than in *aculeata*); 7th intervals slightly elevated at base. *Measurements* (types only): length 5.7–6.7; width 2.5–2.8 mm.

Types. Holotype ♂ (M.C.Z., Type No. 31,429) and 3 paratypes from Dobodura, **Papua**, Mar.–July 1944 (Darlington); 2 additional paratypes from Oro Bay (near Dobodura), Dec. 1943–Jan. 1944 (Darlington); and 4 paratypes from Milne Bay, **Papua**, Dec. 1943 (Darlington).

Additional material. Four from widely scattered localities in **New Guinea**; and 3, **Aru Is.** (British Mus.). Also several doubtfully identified from Wau.

Measured specimens. The ♂ holotype and 1 ♀ paratype from Dobodura.

Notes. This species seems clearly distinct from the preceding one (*subrotunda*): the proportions of head/prothorax and prothoracic width/length reflect the relatively large, wide prothorax of *subrotunda* and the smaller and narrower one of *subquadrata*. However, *aculeata* is intermediate. These 3 species together form a bewildering, variable complex that includes many individuals which I cannot place satisfactorily.

Dolichoctis polita group

The following four species form a group, apparently confined to New Guinea, characterized as follows: form *c.* as in *aculeata* group but more slender; microsculpture absent on head and pronotum, present or absent on elytra; 2 setae over each eye; pronotum with setae (or punctures) at basal

angles but median-lateral setae absent; elytral apices dentate or spined; 1 seta each side last ventral segment in both sexes.

Dolichoctis divisa n. sp.

Description. With characters of genus and of *polita* group; form as in Figure 85; head and prothorax red, elytra black and slightly silky, legs dark, antennae pale; elytra with transverse microsculpture. *Head* 0.63 and 0.67 width prothorax. *Prothorax*: width/length 1.52 and 1.57; base/apex 1.41 and 1.38; sides slightly sinuate before *c.* right (narrowly rounded) basal angles; sides of disc slightly depressed. *Elytra*: width elytra/prothorax 1.35 and 1.37; outer-apical angles *c.* right, apices with moderate spines; striae well impressed, not punctate. *Measurements*: length 6.6–7.4; width 2.6–2.9 mm.

Types. Holotype ♂ (M.C.Z., Type No. 31,430) and 1 ♀ paratype from Dobodura, **Papua**, Mar.–July 1944 (Darlington), and additional paratypes as follows. **Papua**: 2, Bisianumu, E. of Port Moresby, 500 m, Sept. 23, 1955 (Gressitt); 1, Kokoda, 1200 ft. (366 m), Aug. 1933 (Cheesman); 1, Milne Bay, Dec. 1943 (Darlington); 1, Brown River, 20 km N. of Port Moresby, Apr. 29, 1960 (C. W. O'Brien, Bishop Mus.); 1, Popondetta, 60 m, Oct. 18, 1963 (Shanahan, Bishop Mus.); 4, Mt. Lamington, 1300–1500 ft. (*c.* 400–460 m) (C. T. McNamara, S. Australian Mus.).

Measured specimens. The pair (♂ ♀) from Dobodura.

Notes. This strikingly bicolored species is apparently confined to a small part of eastern New Guinea.

Dolichoctis huon n. sp.

Description. With characters of genus and of *polita* group; head and prothorax red, elytra usually darker (castaneous), sometimes scarcely darker; legs and antennae dark; whole upper surface without reticulate microsculpture. *Head* 0.65 and 0.66 width prothorax. *Prothorax*: width/length 1.66 and 1.67; base/apex 1.40 and 1.41; sides slightly sinuate before slightly obtuse (nearly right) basal angles; sides of disc slightly depressed. *Elytra*: width elytra/prothorax 1.39 and 1.40; outer-apical angles *c.* right, apices short-spined or acutely toothed; striae scarcely impressed, formed by rows of small punctures. *Measurements*: length 5.8–6.9; width 2.3–2.8 mm.

Types. Holotype ♂ (Bishop Mus.) and 6 paratypes from Pindiu, Huon Pen., **N-E. N. G.**, 500–600, 750–850, 870–1300 m, Apr. 19, 20, 21, 21–22, 1963 (Sedlacek). Additional paratypes as follows, all from northern part of **N-E. N. G.**: 4, Finschhafen, 10, 80 m, Apr. 12, 16, 1963 (Sedlacek); 1, Lae, 10 m, May 12, 1966 (Gressitt); 1, Busu R., E. of Lae, 100 m, Sept. 15, 1955 (Gressitt); 1, Torricelli Mts., Mobitei, 750 m, Mar. 5–15, 1959 (W. W. Brandt, Bishop Mus.). Some paratypes now in M.C.Z. (Type No. 31,431).

Measured specimens. The ♂ holotype and 1 ♀ paratype from Finschhafen.

Notes. The dark antennae, punctate elytral striae, and absence of elytral microsculpture clearly distinguish this species from *divisa* (above). These 2 species are apparently allopatric, confined to different small areas of eastern New Guinea.

Dolichoctis castanea n. sp.

Description. With characters of genus and of *polita* group; reddish castaneous, prothorax sometimes slightly paler, appendages reddish brown; elytra with transverse reticulate microsculpture. *Head* 0.66 and 0.68 width prothorax. *Prothorax*: width/length 1.62 and 1.63; base/apex 1.32 and 1.31; sides broadly rounded, not or slightly sinuate before usually obtuse basal angles; disc slightly depressed at sides. *Elytra*: width elytra/prothorax 1.33 and 1.45; outer-apical angles distinct but obtuse and slightly blunted, apices short-spined or acutely dentate; striae well impressed, not distinctly punctate. *Measurements*: length 5.4–6.5; width 2.1–2.5 mm.

Types. Holotype ♂ (M.C.Z., Type No.

31,432) and 2 paratypes from Dobodura, **Papua**, Mar.–July 1944 (Darlington); and additional paratypes as follows. **Papua**: 3, Kokoda, 1200 ft., July, Aug. 1933 (Cheesman); 1, Kokoda-Pitoki, 450 m, Mar. 24, 1956 (Gressitt); 2, Mt. Lamington, 1300–1500 ft. (*c.* 400–460 m) (C. T. McNamara, S. Australian Mus.); 1, Brown R., May 25, 1956 (E. J. Ford, Jr., Bishop Mus.). **N-E. N. G.**: 15, Pindiu, Huon Pen., 500–600, 860, 870–1300 m, Apr. 19–22, 1963 (Sedlacek); 1, Busu R. E. of Lae, 100 m, Sept. 14, 1955 (Gressitt); 1, Bubia, Markham Vy., 50 m, Sept. 20, 1955 (Gressitt); 1, Sattelberg, Huon Gulf, 1899 (Biró); 1, Madang (Friedrich-Wilh.-hafen), 1901 (Biró).

Measured specimens. The ♂ holotype and 1 ♀ paratype from Dobodura.

Notes. This species is sympatric with the two preceding ones, but perhaps allopatric with the following (*polita*).

Dolichoctis polita n. sp.

Description. With characters of genus and of *polita* group; reddish castaneous, prothorax sometimes slightly paler, appendages not or slightly paler; entire upper surface without reticulate microsculpture. *Head* 0.66 and 0.66 width prothorax. *Prothorax*: width/length 1.64 and 1.78; base/apex 1.38 and 1.36; sides usually not sinuate before obtuse, sometimes blunted posterior angles; sides of disc moderately depressed. *Elytra*: width elytra/prothorax 1.33 and 1.36; outer-apical angles distinct but obtuse and slightly blunted; apices short-spined or acutely toothed; striae well impressed, impunctate. *Measurements*: length 5.5–6.5; width 2.1–2.6 mm.

Types. Holotype ♂ (Bishop Mus.) and 33 paratypes (some in M.C.Z., Type No. 31,433) from Wau, Morobe Dist., **N-E. N. G.**, altitudes from 1050 to 1500 m, dates in Jan., Feb., Mar., June, July, Sept., Oct., Dec., 1961–1964 (Sedlacek); and 2 paratypes, Upper Watut R., 24 km W. of Bulolo, **N-E. N. G.**, 760 m, Mar. 5–6, 1963 (Sedlacek).

Measured specimens. The ♂ holotype and 1 ♀ paratype from Wau.

Notes. This may be a geographic form (confined to the Morobe area) of *Dolichoctis castanea* (above), distinguished primarily by absence of elytral microsculpture, but I do not care to recognize subspecies in this genus until relationships and geographic patterns are better understood.

Genus *STRICKLANDIA* Macleay

Macleay 1886, Proc. Linnean Soc. New South Wales (2) 1, p. 138.

Diagnosis. Form (Fig. 86) characteristic, large, very broad, depressed; prothorax strongly cordate, with numerous extra lateral setae anteriorly; elytra very wide, each 2-spined. See also *Key to Genera of Lebiini of New Guinea.*

Description. Form broad, depressed; black, moderately shining; not obviously pubescent but pronotum and sometimes other parts of upper surface very inconspicuously sparsely setulose; reticulate microsculpture absent or indistinct on head and disc of pronotum (but pronotal disc transversely rugulose), visible but meshes imperfect and irregular on elytra. *Head*: eyes rather small but prominent; 2 setae over each eye; front flattened, weakly depressed; clypeus subtruncate with rounded angles, 1-setose each side; labrum long, apex subtruncate or slightly broadly emarginate, 6-setose; mandibles moderately long, not strongly arcuate, longitudinally striate above at middle of length; antennae slender, pubescent from middle 4th segments; mentum subtruncate in sinus, slightly lobed or with short blunt tooth; ligula wide at apex, with 2 or 3 large and 2 or more smaller setae, and paraglossae attached to and slightly longer than ligula, without setae; palpi slender, apical segments labial palpi with longitudinal row of numerous setae above. *Prothorax* cordate; base not lobed but irregularly obliquely rounded to basal angles; sides angulate or scalloped at middle, reflexed, with principal setae at basal

angles and near middle and several additional often smaller setae anteriorly; median longitudinal and basal and apical transverse areas impressed; base and apex not distinctly margined. *Elytra* very wide, widest near base; humeri rounded but very prominent; outer-apical and sutural angles both spined; margins finely serrate and setulose; striae entire, punctate; 3rd intervals with 1 or 2 seta-bearing punctures behind middle. *Inner wings* full. *Legs* slender; 4th segments middle and hind tarsi narrow, scarcely emarginate; 5th segments with accessory setae minute (vestigial?); claws with *c.* 4 small teeth, in basal half of claw length. *Secondary sexual characters*: ♂ front tarsi scarcely dilated but 3 segments with small 2-seriate squamae; ♂ middle tarsi without squamae; ♂ middle tibiae not excised; ♂ with 1, ♀ 2 setae each side last ventral segment.

Type species. Stricklandia pericalloides Macleay.

Generic distribution. **New Guinea** (2 or more species); **Moluccas** (1 species, from Batjan Is., Louwerens 1956, Treubia 23, p. 241); **New Britain** (1 probably undescribed species); and North Queensland, **Australia** (1 species). The members of this genus that I have collected live on tree trunks and fallen logs in rain forest.

Notes. I do not know the relationships or geographic origin of this primarily New Guinean genus.

KEY TO SPECIES OF *STRICKLANDIA* OF NEW GUINEA

1. Prothorax narrower (usually *c.* 1.5× wide as long at middle, but sometimes wider), with relatively narrow margins (reflexed margins often less than ¼ as wide as distance from midline to lateral trough, but sometimes wider) (p. 133) ..... *pericalloides*
– Prothorax very wide (*c.* 1.9× wide as long at middle), with very wide margins (reflexed margins more than ½ as wide as distance from midline to lateral trough) (p. 133) ..... *lata*

Stricklandia pericalloides Macleay

Macleay 1886, Proc. Linnean Soc. New South Wales (2) 1, p. 139.

Description. See generic *Diagnosis* and *Description. Head* 0.79 and 0.78 width prothorax. *Prothorax*: width/length 1.48 and 1.56; base/apex 1.18 and 1.15; reflexed margins relatively narrow. *Elytra*: width elytra/prothorax 1.55 and 1.54. *Measurements* (Dobodura series): length *c.* 11.5–13.5 (including elytral spines); width 4.5–5.1 mm.

Type. From Fly R., **Papua**; presumably in Macleay Mus., Sydney (not seen).

Occurrence in New Guinea. Common probably throughout **New Guinea**: 96 specimens (some doubtfully identified, see following *Notes*), from all 3 political divisions of the island; most at low altitudes but reaching *c.* 1500 to 2000 m at several localities including Wau.

Measured specimens. A pair (♂ ♀) from Dobodura, Papua.

Notes. Some individuals tentatively assigned to *pericalloides* have prothoracic margins relatively wide (but not so wide as the following species) and may be specifically distinct, but I do not wish to describe them at present. Mr. Louwerens may refer these individuals to a species he will probably describe from New Britain.

Stricklandia lata n. sp.

Description. With characters of genus; form as in Figure 86, extraordinarily wide; color and surface as described for genus, but elytral microsculpture more transverse than in *pericalloides. Head* 0.64 and 0.68 width prothorax. *Prothorax* wide-cordate; width/length 1.89 and 1.89; base/apex 1.06 and 0.99; margins very wide (*c.* ½ wide as distance from inner edge of margin to middle line), with outer edge irregular. *Elytra*: width elytra/prothorax 1.29 and 1.36. *Measurements*: length *c.* 15–16; width *c.* 6.5 mm.

Types. Holotype ♂ (Leiden Mus.) from Arabu Camp, Wissel Lakes, **West N. G.,** 1800 m, 1939 (H. Boschma), and additional paratypes from Wissel Lakes as follows: 1 ♂ (M.C.Z., Type No. 31,434), Digitara, Oct. 1938 (P. J. Eyma); 1 ♀, Wagete, Tigi

L., 1700 m, Aug. 17, 1955 (Gressitt); 3, Enarotadi, 1850, 1850–1900, 1850–2050 m, dates in July, Aug. 1962 (Sedlacek).

Measured specimens. The ♂ holotype and ♀ paratype from Wagete.

Notes. Distinguished from *pericalloides* by much wider prothorax and other differences of proportion shown by ratios in the *Descriptions.*

Genus *PELIOCYPAS* Schmidt-Goebel

Schmidt-Goebel 1846, Faunula Coleop. Birmaniae, p. 33.
Jeannel 1949, Coléop. Carabiques de la Région Malgache, Part 3, p. 991.
Demetrias Csiki 1932 (in part), Coleop. Cat., Carabidae, Harpalinae 7, p. 1386 (see for additional references).
Risophilus Jedlicka 1963 (not Leach), Ent. Abhandlungen 28, p. 401.

Diagnosis. In New Guinea, the form (Fig. 87), small size (under 5 mm), and long-lobed 4th tarsal segments are diagnostic.

Description. None required here. See detailed description of following new species.

Type species. P. suturalis Schmidt-Goebel, of Burma, etc.

Generic distribution. Southern and eastern **Asia** to the **Philippines** and **New Guinea** (not Australia); **Africa**, **Madagascar**.

Notes. Generic distinctions and applications of generic names have been confused in the group of genera to which this genus belongs. In my present use of *Peliocypas* I am following Jeannel, although I do not like his multiplication of higher categories.

Peliocypas papua n. sp.

Description. Form as in Figure 87; brown, appendages slightly paler; not pubescent; rather shining, reticulate microsculpture lightly impressed and irregular, *c.* isodiametric on head and elytra, slightly transverse on disc of pronotum. *Head* 0.97 and 0.97 width prothorax (measured at middle); eyes moderately prominent; 2 setae over each eye; front slightly impressed at sides between eyes and at sides anteriorly; frontal suture indicated but not impressed; clypeus subtruncate, 1-setose each side; labrum transverse, subtruncate with rounded angles, 6-setose; mentum with strong triangular tooth; ligula rounded-subtruncate, apparently 2-setose, with paraglossae of *c.* same length, apparently attached, narrowly rounded, without setae. *Prothorax* subquadrate, widest at base, with anterior angles rounded; width (at middle)/length 1.15 and 1.24; base/apex 1.38 and 1.47; base and apex subtruncate (base slightly sinuate), not margined; side margins narrow, broader basally and reflexed and running into deep baso-lateral impressions, each margin with setae at basal angle and *c.* ¼ from apex; disc with usual median line and transverse impressions and lightly transversely strigulose. *Elytra*: width elytra/prothorax 2.04 and 2.14; humeri broadly rounded but not much narrowed; apices obliquely sinuate-truncate, outer angles rounded, sutural angles blunted; striae entire but light, not punctate; 3rd intervals with 2 conspicuous dorsal punctures *c.* ¼ from base and ¼ from apex. *Inner wings* full. *Legs* slender; 4th segments of middle and hind tarsi with long lobes; 5th segments with accessory setae; claws each with 1 long tooth outside and 2 smaller teeth inside middle of length. *Secondary sexual characters*: ♂ front tarsi with squamae (if present) not clearly differentiated; last ventral segment with apex deeply notched in ♂, entire in ♀; ♂ with 1, ♀ 2 setae each side apex last ventral segment. *Measurements*: length *c.* 4.0–4.5; width *c.* 1.8–1.9 mm.

Types. Holotype ♂ (Hungarian National Mus.) and 5 paratypes (2 in M.C.Z., Type No. 31,435) all from Madang ("Friedrich-Wilh.-hafen"), **N-E. N. G.,** 1901 (Biró).

Measured specimens. The ♂ holotype and 1 ♀ paratype.

Notes. This is the easternmost species of a genus or group of genera very well

represented in the Orient. In Jedlicka's (1963, pp. 401–402) key to the species of "*Risophilus*," *papua* runs to couplet 5 but fits neither species there named, being narrower-headed than *unicolor* Jedlicka and smaller than *vimmeri* Jedlicka.

Genus *CELAENEPHES* Schmidt-Goebel

Schmidt-Goebel 1846, Faunula Coleop. Birmaniae, p. 77.
Csiki 1932, Coleop. Cat., Carabidae, Harpalinae 7, p. 1412 (see for synonymy and additional references).
Jedlicka 1963, Ent. Abhandlungen 28, p. 399.

Diagnosis. See *Key to Genera of Lebiini of New Guinea* and *Description* of following species.

Description. None required here.

Type species. Celaenephes parallelus Schmidt-Goebel (below).

Generic distribution. That of the single species.

Notes. I do not know the relationships of this monotypic genus.

Celaenephes parallelus Schmidt-Goebel

Schmidt-Goebel 1846, Faunula Coleop. Birmaniae, p. 77.
Van Emden 1937, Stettiner Ent. Zeitung 98, p. 35.
Andrewes 1947, Arkiv för Zool. 38A, No. 20, p. 12.
Louwerens 1956, Treubia 23, p. 225 (Moluccas).
See additional references under genus.

Description (for recognition only). Form as in Figure 88; slender, with elytral apices simply rounded-truncate; plain black or piceous; mentum not toothed; claws not toothed; length *c.* 6.5–7.5 mm.

Type(s). From **Burma**; in Prague Mus. (not seen).

Occurrence in New Guinea. Common throughout New Guinea and on Normanby Is.: 206 specimens, most at low altitudes but a few up to 1550 and 1700 m; found at Dobodura and Wau.

Notes. This easily recognized carabid ranges at least from **Ceylon**, extreme **NE. India** (not peninsular India, according to Andrewes), **Burma**, etc. to the **Philippines** and northern **Australia**, and east to **New Britain**, **New Ireland**, the **Solomons**, **Fiji**, **Samoa**, and **New Caledonia** (specimens seen from all these islands). It lives in foliage and may (I think) have been carried eastward into the Pacific by man, perhaps in thatching material.

Genus *SYNTOMUS* Hope

Hope 1838, Coleop. Manual 2, p. 64.
Jeannel 1942, Faune de France, Coléop. Carabiques, Part 2, p. 1075.
Metabletus Schmidt-Goebel 1846, Faunula Coleop. Birmaniae, p. 38.
Csiki 1932, Coleop. Cat., Carabidae, Harpalinae 7, p. 1413 (see for additional references, synonymy, and list of species).
Jedlicka 1963, Ent. Abhandlungen 28, p. 420.

Diagnosis. Known among New Guinean Lebiini by small size, form (Fig. 89), mentum with emarginate tooth, and tarsal claws with 2 or 3 minute inconspicuous oblique teeth.

Description. None required here.

Type species. Of *Syntomus, Carabus truncatellus* Linnaeus, of Europe; of *Metabletus, M. obscuroguttatus* Schmidt-Goebel, of Burma, etc.

Generic distribution. Temperate and tropical **Eurasia** and across the islands to North Queensland, **Australia**; **North America**; parts of **Africa**.

Notes. Only one, widely distributed species of this genus reaches New Guinea.

Syntomus quadripunctatus (Schmidt-Goebel)

Schmidt-Goebel 1846, Faunula Coleop. Birmaniae, p. 39 (*Metabletus*).
Csiki 1932, Coleop. Cat., Carabidae, Harpalinae 7, p. 1418 (see for synonymy and additional references).

Description (for recognition only). With characters of genus; form as in Figure 89; black; upper surface dull but not pubescent; elytra with 3rd intervals 2-punctate; length *c.* 3.5 mm.

Type(s). From **Burma**; in Prague Mus. (not seen).

Occurrence in New Guinea. **N-E. N. G.**: 4, Wau, Morobe Dist., 1250 m, dates in Jan., Feb., Sept. 1961, 1962 (Sedlacek); 1,

Mt. Missim (near Wau), 1050 m, Dec. 27, 1962 (Sedlaceks); 1, Mt. Missim (Stevens, M.C.Z.); 1, Finschhafen, Apr. 1944 (E. S. Ross, Cal. Acad.). **West N. G.**: 1, Eramboe, 80 km ex Merauke, Jan. 29, 1960 (T. C. Maa, Bishop Mus.).

Notes. The known range of *S. quadripunctatus* is from **SE. Asia** including **Ceylon**, **Burma**, and **Japan** across the **Malay Archipelago** to the **Philippines**, **New Guinea**, and the NE. corner of **Australia**. Occurrence in Australia is based on a single teneral ♀ that I collected N. of Mareeba, North Queensland, Feb. 1958.

Genus *MICROLESTES* Schmidt-Goebel

Schmidt-Goebel 1846, Faunula Coleop. Birmaniae, p. 41.

Csiki 1932, Coleop. Cat., Carabidae, Harpalinae 7, p. 1420 (see for additional references, synonymy, and list of species).

Jeannel 1942, Faune de France, Coléop. Carabiques, Part 2, p. 1084.

Mateu 1959, Rev. française d'Ent. 26, pp. 135 ff. (species of tropical Asia).

——— 1963, Ann. Mus. R. l'Afrique Central, Ser. in-8°, No. 121, pp. 1–149 (monograph of African species).

Jedlicka 1963, Ent. Abhandlungen 28, p. 425.

Diagnosis. Distinguished among New Guinean Lebiini by small size, form (note genae not swollen, prothorax lobed at base), mentum without tooth, and tarsal claws toothed (teeth few and minute in *curtatus*).

Description. None required here.

Type species. Microlestes inconspicuus Schmidt-Goebel, of Burma, etc.

Generic distribution. Warm-temperate and tropical **Africa** and **Eurasia** and islands to **Australia**; **North America**; scattered records elsewhere.

Notes. Two unrelated species occur in New Guinea, one with Oriental and the other with apparent Australian relationships.

Key to Species of *Microlestes* of New Guinea

1. Relatively broad (prothoracic width length 1.50); elytra with 2 incomplete pale fasciae; length 3.8 mm (p. 136) ..... *cinctus*
– Narrower (prothoracic width/length 1.18 and 1.28); dull black, not marked; length not over 3.2 mm (p. 136) ..... *curtatus*

Microlestes cinctus n. sp.

Description. Form as in Figure 91; black, in part slightly brownish, elytra with 2 incomplete transverse fasciae testaceous, appendages irregularly brownish, bases of femora and of antennae slightly darker; rather shining, upper surface with reticulate microsculpture of meshes isodiametric on head and pronotum, less regular and slightly transverse on elytra. *Head* 0.79 and 0.77 width prothorax. *Prothorax* wide-subcordate; width/length 1.50 and 1.55; base/apex 1.12 and 1.14; sides rather narrowly margined, each margin with setae at base and *c.* ⅓ from apex; usual discal impressions present but weak. *Elytra*: width elytra/prothorax 1.67 and 1.56; striae lightly impressed, minutely irregular or faintly punctulate; intervals sparsely minutely punctulate, 3rd with 1 seta-bearing puncture, on inner edge *c.* ¼ from apex. *Legs*: claws each with *c.* 4 distinct, oblique teeth. *Measurements*: length 3.6–3.8; width 1.7 mm.

Type. Holotype ♂ (Bishop Mus.) from Feramin, **N-E. N. G.,** 1200–1500 m, May 11–22, 1959 (W. W. Brandt); 1 ♂ paratype, Okapa (Okasa), **N-E. N. G.,** July 8, 1965 (Hornabrook), "pine forest, leaf mold."

Notes. Of other species known to me, this is most like *M. atrifasciatus* Sloane of NE. Australia (base of Cape York Pen. to northern New South Wales), but the color pattern is different, the elytra in *atrifasciatus* being testaceous with a dark irregular postmedian fascia and subapical and sublateral dark spots.

Microlestes curtatus n. sp.

Description. Form as in Figure 90; slender, with elytra much shorter than abdomen; dull brownish black, appendages dark; entire upper surface with reticulate microsculpture irregular (partly longitudinal) on head, slightly transverse on pronotum and elytra. *Head* 0.92 and 0.89 width prothorax. *Prothorax* narrow-subcordate; width/length

1.18 and 1.28; base/apex 1.08 and 1.04; side margins very narrow, each with setae at basal angle and *c.* ¼ from apex; disc with median line impressed, transverse impressions scarcely indicated. *Elytra* very short, narrowed anteriorly; width elytra/prothorax 1.68 and 1.64; striae lightly indicated, sometimes scarcely visible, irregular but not distinctly punctate; 3rd intervals with 2 punctures, before middle and *c.* ¼ from apex. *Legs*: claws each with *c.* 2 small oblique teeth, easily overlooked. *Measurements*: length to apex elytra 2.4–2.6, to apex abdomen 2.8–3.2; width 1.0–1.1 mm.

Types. Holotype ♂ (M.C.Z., Type No. 31,436) and 28 paratypes all from central plains of Luzon, **Philippine Is.,** Feb.–Sept. 1945 (Darlington).

Occurrence in New Guinea. **West N. G.**: 2, Dor(e)y (probably collected by Wallace, British Mus.; this locality is, of course, somewhat doubtful).

Measured specimens. The ♂ holotype and 1 ♀ paratype from central plains of Luzon.

Notes. I have based this new species on Philippine individuals because of doubt about Wallace's locality "Dorey" (see Part 1 of my work on New Guinean Carabidae, pp. 330–331).

M. curtatus is similar to *exilis* Schmidt-Goebel but has shorter elytra. This species (*curtatus*) with very short elytra is not represented in the Andrewes Collection and was evidently not known to Mateu (1959) or Jedlicka (1963). It is unknown in Australia.

Genus *APRISTUS* Chaudoir

Chaudoir 1846, Enumération des Carabiques . . . Caucase . . ., p. 42.
Csiki 1932, Coleop. Cat., Carabidae, Harpalinae 7, p. 1432 (see for additional references, synonymy, and list of species).
Jeannel 1942, Faune de France, Coléop. Carabiques, Part 2, p. 1083.
Jedlicka 1963, Ent. Abhandlungen 28, p. 427.

Diagnosis. Very small Lebiini, recognizable (in New Guinea) by form (Fig. 92); surface not pubescent but all or part (at least elytra) dull and heavily microreticulate; genae not swollen; mentum with entire tooth; claws not toothed.

Description. None required here.

Type species. Apristus subaeneus Chaudoir, of the Caucasus and Mediterranean region.

Generic distribution. Warm-temperate and tropical **Eurasia** and the **Malay Archipelago** to the **Philippines** and **New Guinea** (not Australia); part of **Africa** (not Madagascar); **North** and **Central America**, **Cuba**.

Notes. American species of this genus, which are the only ones I have collected, live on the ground, usually on sand or gravel near water.

Key to Species of *Apristus* of New Guinea

1. Color brownish bronze; entire upper surface dull; length 3.0–3.5 mm (p. 137) *biroi*
– Color bluish black; front of head and middle of pronotum relatively shining, elytra dull; length 3.5–3.9 mm (p. 137) *sedlaceki*

Apristus biroi n. sp.

Description. With characters of genus; form as in Figure 92; brownish bronze, including appendages; entire upper surface dull, heavily microreticulate. *Head* 0.90 and 0.90 width prothorax. *Prothorax*: width/length 1.28 and 1.30; base/apex 0.91 and 0.90. *Elytra*: width elytra/prothorax 1.64 and 1.70. *Measurements*: length 3.0–3.5; width 1.2–1.5 mm.

Types. Holotype ♂ (Hungarian National Mus.) and 5 paratypes (2 in M.C.Z., Type No. 31,437) all from Madang ("Friedrich-Wilh.-hafen"), **N-E. N. G.,** 1901 (Biró).

Measured specimens. The ♂ holotype and 1 ♀ paratype.

Notes. Similar to *A. louwerensi* Andrewes of Java, but with elytra more narrowed anteriorly and with fainter striae.

Apristus sedlaceki n. sp.

Description. With characters of genus; form *c.* as in preceding (*biroi*) except sides of prothorax more rounded anteriorly and much more strongly sinuate *c.* ⅓ from

base; bluish black, appendages dark; front of head shining with reticulate microsculpture faint and fragmentary, middle of pronotal disc ± shining, rest of upper surface including elytra (except edges of suture) microreticulate and dull. *Head* 0.92 and 0.91 width prothorax. *Prothorax*: width/length 1.22 and 1.25; base/apex 0.94 and 0.91. *Elytra*: width elytra/prothorax 1.82 and 2.00. *Measurements*: length 3.5–3.9; width 1.5–1.8 mm.

Types. Holotype ♂ (Bishop Mus.) and 2 paratypes (1 in M.C.Z., Type No. 31,438) from Tobo-Salembeng, Huon Pen., **N-E. N. G.,** Apr. 26, 1963 (Sedlacek); 1 paratype, Golden Pines, Bulolo, **N-E. N. G.,** 600 m, Feb. 19, 1962 (Sedlacek); and 1 paratype, Zengaren, **N-E. N. G.,** 1500 m, Apr. 28, 1963 (Sedlacek).

Measured specimens. The ♂ holotype and 1 ♀ paratype from Tobo-Salembeng.

Notes. This may be related to *A. cuprascens* Bates (described from Japan and identified from the Philippines by Andrewes), but the color of *sedlaceki* is bluish rather than cupreous, the front is more shining than in *cuprascens*, and comparison of specimens shows slight differences of form not worth describing in detail here.

(Genus *PLOCHIONUS* Latreille & Dejean)

Latreille & Dejean 1824, Histoire Naturelle et Iconographie Coléop. d'Europe 1, p. 150.
Csiki 1932, Coleop. Cat., Carabidae, Harpalinae 7, p. 1451 (see for additional references, synonymy, subgenera, and list of species).
Jeannel 1942, Faune de France, Coléop. Carabiques, Part 2, p. 1033.

Diagnosis. See *Key to Genera of Lebiini*, and *Description* of following species.

Description. None required here.

Type species. Carabus pallens Fabricius (below).

Generic distribution. Native in tropical and subtropical **America**, with the following species now *c.* **cosmopolitan**.

Notes. A supposed endemic *Plochionus* in New Caledonia needs confirmation.

(*Plochionus pallens* (Fabricius))

Fabricius 1775, Systema Ent., p. 244 (*Carabus*).
Britton 1948, Proc. Hawaiian Ent. Soc. 13, p. 237 (Hawaii).
Jedlicka 1963, Ent. Abhandlungen 28, p. 450.
See also references under genus.

Description (for recognition only). Form as in Figure 93; brown; not pubescent; ♂ front and middle tarsi slightly dilated, 2-seriately squamulose; ♂ middle tibiae arcuate, lower edges broadly shallowly emarginate below near middle of length; length *c.* 7–9.5 mm.

Type. From **Europe** ("Habitat Dresdae"), now presumed lost (not seen).

Occurrence in New Guinea. Not yet found, but likely to occur.

Notes. This species, probably originally from **America**, has been carried by man to most of the warmer parts of the **world**. In the Asiatic-Pacific region it is known from **SE. Asia**, **Sumatra**, **Java**, **New Britain**, **New Ireland**, **New Hebrides**, **Fiji**, and **Polynesia** including **Hawaii**.

Genus *PARENA* Motschulsky

Motschulsky 1859, Étude Ent. 8, p. 31.
Csiki 1932, Coleop. Cat., Carabidae, Harpalinae 7, p. 1453 (see for additional references, synonymy, and list of species).
Jeannel 1949, Coléop. Carabiques de la Région Malgache, Part 3, pp. 948, 971.
Jedlicka 1963, Ent. Abhandlungen 28, p. 439.

Diagnosis. See *Key to Genera of Lebiini of New Guinea* and Figure 94; note form stout, surface not pubescent, 4th tarsal segments long-lobed; length *c.* 8–10 mm.

Description. None required here.

Type species. Parena bicolor Motschulsky, of Java.

Generic distribution. Most species in area from **SE. Asia** (including **Japan**) to northern **Australia**, fewer in **Africa** and **Madagascar**.

Notes. The 3 species that have been found in New Guinea represent 3 independent, widely distributed stocks. Further study is needed to clarify their geographic variation and nomenclature; my present

material is inadequate. I shall therefore treat the species only briefly.

All members of this genus that I know are winged and arboreal.

KEY TO SPECIES OF *PARENA* OF NEW GUINEA

1. Color entirely testaceous (with sometimes *vague* posterior elytral cloud pale brown); tarsi and antennae contrastingly black (p. 139) ..... *testacea*
– Color partly or wholly darker; tarsi and antennae reddish testaceous 2
2. Color testaceous or reddish testaceous with very broad, well defined black elytral fascia (p. 139) ..... *fasciata*
– Color irregular rufo-piceous, without well defined elytral marking (p. 139) ..... *picea*

Parena testacea (Chaudoir)

Chaudoir 1872, Ann. Soc. Ent. Belgium 15, p. 178. (*Crossoglossa*).

Description. None required here; see preceding *Key*; length (in New Guinea) *c.* 10 mm.

Types. From the Deccan, **India**; now in Oberthür Coll., Paris Mus. (not seen).

Occurrence in New Guinea. **N-E. N. G.**: 4, Wau, Morobe Dist., 1200 m, June 25, Oct. 11–18, Nov. 19, Dec. 5–6, 1961 (Sedlaceks).

Notes. This species is now known from **India**, (**China**?), **Sumatra**, **Java** ("variety" *cruralis* Andrewes), and **New Guinea** (not Australia).

Parena fasciata (Chaudoir)

Chaudoir 1872, Ann. Soc. Ent. Belgium 15, p. 179 (*Crossoglossa*).
Jedlicka 1963, Ent. Abhandlungen 28, pp. 440, 443, fig. 154.
sloanei Csiki 1932, Coleop. Cat., Carabidae, Harpalinae 7, p. 1455 (new synonymy).
plagiata Macleay 1876, Proc. Linnean Soc. New South Wales 1, p. 167 (*Phloeodromius*) (new synonymy).

Description (for recognition only). Form as in Figure 94; yellow or reddish yellow with conspicuous, broad, transverse, black elytral fascia; length (in New Guinea) *c.* 8–9 mm.

Types. Of *fasciata*, from the **Moluccas**, now in Oberthür Coll., Paris Mus.; of *plagiata*, from Yule Is., Hall Sound, **Papua**, in Macleay Mus., Sydney; of *sloanei* (new name), as for *plagiata* Macleay (none seen).

Occurrence in New Guinea. **Papua**: Yule Is. (type of *plagiata*). **N-E. N. G.**: 1, Lae, July 1944 (F. E. Skinner, Purdue U. Coll., Bishop Mus.); 1, Busu R. E. of Lae, 100 m, Sept. 13, 1955 (Gressitt); 1, Bulolo, 732 m, Aug. 18, 1956 (E. J. Ford, Jr., Bishop Mus.), in light trap; 1, Finschhafen, Huon Pen., 180 m, Apr. 16, 1963 (Sedlacek); 1, Mumeng, 600 m, Mar. 10, 1962 (Sedlacek). **West N. G.**: 2, Hollandia, 250 ft., May 4, Nov. 3, 1944 (Hoogstraal, M.C.Z.).

Notes. I have seen specimens that I refer to this species from **Java**, **Borneo**, the **Philippines** (including Luzon), **Celebes**, the **Moluccas**, **New Britain**, and northern **Australia**, as well as **New Guinea**.

Parena picea (Macleay)

Macleay 1871, Trans. Ent. Soc. New South Wales 2, p. 86 (*Phloeodromius*).

Description. None required here; see preceding *Key*; length (in New Guinea) *c.* 9–10 mm.

Types. One specimen from Gayndah, South Queensland, **Australia** (probably now in Macleay Mus., Sydney) is presumably the actual type (not seen), although Macleay mentions also "a few specimens from other portions of Queensland."

Occurrence in New Guinea. **N-E. N. G.**: 1, Wau, Morobe Dist., 1200 m, Feb. 25, 1963 (Sedlaceks). **West N. G.**: 1, Nabire, S. Geelvink Bay, 10–40 m, Sept. 1–4, 1962 (Sedlacek).

Notes. I have no specimens from Australia and have identified the New Guinean ones from the original description. I also tentatively assign to this species single individuals from **New Britain** and **Manus Is.** (Bishop Mus.).

Genus *ANCHISTA* Nietner

Nietner 1856, J. Asiatic Soc. Bengal 6, p. 523.
Csiki 1932, Coleop. Cat., Carabidae, Harpalinae 7, p. 1455 (see for additional references, synonymy, and list of species).
Jedlicka 1963, Ent. Abhandlungen 28, p. 449.

Diagnosis. See *Key to Genera of Lebiini of New Guinea*, and under following species.

Description. None required here.

Type species. Lebia brunnea Wiedemann, of India and Ceylon.

Generic distribution. The few known species are confined to **SE. Asia** including **Ceylon** and **Japan**, except that one (below) is widely distributed on the **Malay Archipelago** and islands of the **western Pacific**.

Notes. I know nothing about the habitat or habits of members of this genus.

Anchista binotata (Dejean)

Dejean 1825, Species Général Coléop. 1, p. 252 (*Plochionus*).
See also references under genus.

Description (for recognition only). Form as in Figure 95; brownish piceous, each elytron with longitudinal testaceous area centered before middle; surface not pubescent; 5th intervals with conspicuous seta-bearing puncture at base; length *c.* 8–9 mm.

Type(s). From the **Marianas**; now in Oberthür Coll., Paris Mus. (not seen).

Occurrence in New Guinea. **Papua**: 1, Hagita, near Milne Bay, Aug. 10, 1919 (J. T. Zimmer, Chicago Mus.).

Notes. This species has now been found in **SE. Asia** (**India** to **Japan**), the **Andaman Is.**, **Sumatra**, **Java**, **Borneo**, the **Philippines**, **Buru**, **New Guinea**, and the **Marianas**. It has probably been dispersed partly by man.

Genus *ENDYNOMENA* Chaudoir

Chaudoir 1872, Ann. Soc. Ent. Belgium 15, p. 186.
Csiki 1932, Coleop. Cat., Carabidae, Harpalinae 7, p. 1457 (see for additional references, synonymy, and list of species).
Jedlicka 1963, Ent. Abhandlungen 28, p. 308.

Diagnosis. See *Key to Genera of Lebiini of New Guinea.*

Description. None required here.

Type species. Plochionus pradieri Fairmaire (below).

Generic distribution. **SE. Asia** including **Japan**, with the following species very widely spread over the islands of the **Pacific** presumably carried by man.

Notes. The habitat and habits of this genus too are unknown to me.

Endynomena pradieri (Fairmaire)

Fairmaire 1849, Revue and Magazine Zool. 1, pp. 34, 281.
See also references under genus.

Description (for recognition only). Form as in Figure 96; brown or piceous; surface with short pubescence; length *c.* 8 mm.

Type. From **Tahiti**; in Oberthür Coll., Paris Mus. (not seen).

Occurrence in New Guinea. **N-E. N. G.**: 1, Sepik, Maprik area, 160 m, Aug. 29, 1957 (Hardy, Bishop Mus.), at light.

Notes. This insect has been recorded from parts of **SE. Asia**, **Sumatra**, the **Philippines**, **Fiji**, **Samoa**, **Tonga**, **New Caledonia**, **Tahiti**, **Hawaii**, and other remote **Pacific islands**, and I have seen a specimen from **New Britain** (Bishop Mus.).

Genus *DEMETRIDA* White

White 1846, Voyage Erebus & Terror, p. 2.
Csiki 1932, Coleop. Cat., Carabidae, Harpalinae 7, p. 1459 (as subgenus of *Xanthophoea*) (see for additional references).
Britton 1941, Proc. R. Ent. Soc. London (B) 10, p. 188.
Xanthophoea Chaudoir 1848, Bull. Soc. Nat. Moscow 21, Part 1, p. 73.

Diagnosis. Among New Guinean Lebiini of the same general form (Figs. 97–109) and size (5.5–12.0 mm), the species of *Demetrida* are distinguished by tarsi pubescent (sparsely pilose) above, with 4th segment long-lobed and tarsal claws with several or many long teeth; ligula and paraglossae joined, rounded-truncate, usually 4-setose (sometimes with 2 additional smaller setae); palpi not widely expanded; and ♂ middle tibiae usually (not always) with inner edge in apical $^1/_3$ or $^1/_2$ of length with a row of several low tubercles.

Description (applicable to all New Guinean species). Form usually slender (broadest in *imitatrix*), convex; color diverse, brown or black or metallic, uniform

or bicolored or tesselated (but pattern not geometric and not simply 2-maculate); upper surface with short or long pubescence or not pubescent; reticulate microsculpture variable, rarely present on whole upper surface, often present only on elytra, sometimes absent; elytral reticulations *c.* isodiametric or slightly transverse when not otherwise described. *Head* narrower than or wider than prothorax; eyes prominent but varying from species to species; genae usually shorter than eyes and oblique, rarely angulately prominent; 2 setae over each eye, the posterior often distant from posterior corners of eyes; front impressed each side anteriorly, often also flattened and/or weakly impressed or subpunctate at middle; mandibles short, strongly curved; clypeus 1-setose each side; labrum transverse, 6-setose anteriorly, with additional smaller depressed setae at rounded angles; antennae slender, pubescent from (part of) 4th segments, first 3 segments more sparsely or not pubescent; mentum with entire tooth; ligula and paraglossae equal in length, united, forming a rounded-truncate structure with 4 principal setae and sometimes 2 additional smaller setae; palpi pubescent, not widely expanded. *Prothorax* cordate or quadrate or trapezoidal, often (not always) as long or longer than wide, sometimes (not usually) wider at base than at middle (but width of prothorax always measured at widest midpoint in computing proportions); side margins varying in width in different species, each margin with a seta at or before middle and sometimes also a seta at or near basal angle, and in *seticollis* with additional setae anteriorly (setae often broken off, but their positions marked by characteristic punctures); disc convex, more so in some species than in others; anterior and posterior marginal lines absent or incomplete, middle line very coarse and deep (except finer in *kokoda*), but subbasal and subapical transverse impressions weak or obsolete; basolateral impressions usually present but not sharply defined, usually subpunctate, but disc otherwise *c.* smooth or at most sparsely punctulate. *Elytra* with humeri rounded, margined; outer apical angles rounded or angulate or denticulate; actual apices obliquely truncate or sinuate-emarginate or angulate, denticulate, or spined *c.* opposite ends of 2nd intervals or 2nd striae; striae entire, usually well impressed, sometimes punctulate; intervals flat or moderately convex, 3rd with 1 (in *tenuis* only) or 2 or more dorsal, usually seta-bearing punctures, and 5th intervals rarely with similar punctures; when 3rd intervals 2-punctate, the punctures often ¼ or less from base on outer edge and ¼ or less from apex on inner edge of intervals, but positions vary; additional punctures (if present) on 3rd intervals sometimes smaller and more irregular than the 2 primary punctures. *Inner wings* full in all New Guinean species (reduced in some New Zealand and Australian ones). *Lower surface* variable, often sparsely or partly pubescent (least so in *imitatrix*); prosternal process variable in profile. *Legs* slender; tarsi pubescent (sparsely pilose) above; 4th tarsal segments very deeply emarginate, with long lobes; 5th segments with accessory setae; claws each with 3 to 8 long teeth (not counting apex of claw) and sometimes additional smaller teeth, the number varying from species to species and also varying a little individually, sometimes different on the 2 claws of one tarsus. *Secondary sexual characters*: ♂ front tarsi not or not much dilated but with 3 segments narrowly 2-seriately squamulose below (the squamae sometimes disarranged and not obviously 2-seriate); ♂ middle tarsi without sexual squamules; *either* ♂ middle tibiae each with a row of 3 to 9 low tubercles on inner edge in outer ⅓ or ½ of length, the tibial edge being thus subsinuate or subserrate in profile (Fig. 160) (this condition called tuberculate-serrate), *or* ♂ middle tibiae modified in some other way, *or* ♂ middle tibiae either straight or slightly bent-in at apex but without tubercles (Fig.

161) (see *Notes* below); last ventral segment with 2 to 4 apical setae each side in ♂ (possibly only 1 each side in ♂ *tenuis*), 3 to 8 or more in ♀ (except only 2 each side in ♀ *tenuis*), the number in each sex usually fairly constant in a species but varying somewhat individually and sometimes unsymmetric with (for example) 2 setae on one side and 3 on the other in a ♂, or 5 on one side and 6 on the other in a ♀.

Type species. So far as I know, type species have not been strictly designated for either *Demetrida* or *Xanthophoea*. These genera were based on New Zealand and Australian forms respectively, and type species should be selected during work on the New Zealand and Australian members of the group. I therefore make no designations now.

Generic distribution. Numerous in **Australia** and **New Guinea**, fewer in **New Zealand**, **New Caledonia**, **New Britain**, and the **Moluccas** (Amboina, Batjan) (occurrence in New Britain and Moluccas based on undescribed material before me).

Notes. As Britton points out, *Demetrida* has priority over *Xanthophoea*. The genus as a whole is diverse. Perhaps it can be usefully divided, but this will require revision of the many Australian species, which seem to bridge the gap between the flightless (ground-living?) *Demetrida* of New Zealand and the winged (arboreal) species of New Guinea.

The New Guinean species of *Demetrida* may all be interrelated but different ones differ remarkably in many details. Variation of some characters within the genus is indicated in the preceding *Description*, and some species groupings are suggested in the *Key to Species*. However, differences in the ♂ middle tibiae, which may distinguish natural species groups, are worth describing in more detail. Of the 56 species of the genus now recognized from New Guinea, both sexes are known of 47, only the ♂ of 4, and only the ♀ of 5. In most species of which the ♂ is known, and also in at least some Australian and New Zealand species, the ♂ middle tibiae have the inner edge tuberculate-serrate (see *Description*, above). The number of tubercles varies from *c.* 3 to 9 in different species (with some individual variation too), and the tubercles vary in prominence, being sometimes poorly developed and difficult to see. The tuberculate-serrate ♂ middle tibiae probably characterize most *Demetrida* throughout the genus' range. However, variations from this pattern occur among New Guinean species. In *D. nigripennis* (and perhaps also in *prima*, of which the ♂ is unknown) the ♂ middle tibiae have the inner edge weakly 2-emarginate. In ♂ *imitatrix* each middle tibia has a long tubercle on inner edge separated from the apex by an emargination. And the following 16 species have the ♂ middle tibiae straight or slightly bent-in (slightly bent-out in *reversa*) at apex but not or not distinctly tuberculate-serrate: *tripuncta, genicula, angulata, reversa, kiunga, recta, rex, brunnea, fumipes, nigriceps, saidor, divisa, humeralis, viridibasis, mafulu*, and *sibil*.

Because of the large number of species and because many characters are shared by related species or convergent in unrelated ones, most New Guinean *Demetrida* can be defined only by combinations of characters. However, *D. imitatrix* is unique in form (relatively broad) and in form of ♂ middle tibiae. *D. vigil* is unique in abrupt prominence of eyes. *D. kokoda* is unique in form and in fineness of impressed middle line of pronotum. *D. seticollis* is unique (among the nonpubescent species) in possessing extra lateral pronotal setae anteriorly. And *D. tenuis* is unique in sculpture of front, in having only 1 seta-bearing puncture on 3rd elytral interval, and in having only 1 apical seta on each side in the ♂, and only 2 in the ♀. Besides these single species with unique characters, the following pairs or small groups of species share special characters. Among New Guinean *Demetrida*, only *velata, viridibasis*, and *mafulu* have

almost the whole upper surface microreticulate; only *tripuncta* and *genicula* have the genae *strongly* angulately prominent, although *tenuis* and some other species have the genae subprominent; only *seriata* and *nubicola* (of nonpubescent species) have special seta-bearing punctures on 5th elytral intervals; and only *nigripennis* and perhaps *prima* have the ♂ middle tibiae 2-sinuate on inner edge.

Some New Guinean species of *Demetrida* are remarkably variable. Great individual variation is indicated by differences in proportions of the *Measured specimens* of some species. And Mendelian dimorphism is suggested in some cases. For example, dimorphism or polymorphism of color apparently occurs in *Demetrida diversa* (markings black or green, legs dark or pale) and in *mafulu* (markings present or absent), and color differences among some other species *may* be Mendelian, and presence or absence of certain prothoracic and elytral setae *may* be Mendelian too, as is the case among some other Carabidae. (Genetic dimorphism of these and other Carabidae will be considered in more detail in Part IV of my work on the carabid beetles of New Guinea.) This situation suggests that the explosive evolution of *Demetrida* in New Guinea, discussed below, is correlated with great genetic variability of some species, as would be expected. Different species may still share homologous genes, and characters that have become stabilized in some species may still be dimorphic or polymorphic in other species.

I think that *Demetrida* is in fact in the very midst of an evolutionary explosion in New Guinea. This is suggested by the diversity of superficial differences among many apparently closely interrelated species and by the great variability of some species. Apparently one or more ancestors have *recently* invaded an open or incompletely occupied habitat in New Guinea—primarily the low foliage of rain forest—where other predaceous beetles of this size are few. This habitat is occupied in other tropical regions by Carabidae of the genus *Calleida*, which many of the New Guinean *Demetrida* resemble in size, form, and even color, although the two genera are well differentiated taxonomically by differences in mouthparts, tarsal pubescence, etc. That *Demetrida* and *Calleida* are geographically complementary is true but an oversimplification. The situation is complicated in many ways, for example by the presence of many species of *Lebia* in some other tropical regions but few in New Guinea.

The ecology of *Demetrida* seems consistent with a recent *independent* radiation of the New Guinean species. While most New Guinean species apparently live in foliage in rain forest, most Australian species live on shaggy-barked tree trunks (especially of *Eucalyptus* trees) in relatively open woodland, and the Australian tree-trunk forms and the New Guinean rain-forest-foliage forms have evidently radiated independently. Although this is true, it is another oversimplification. A few northern Australian species of *Demetrida* do inhabit rain-forest foliage, but they are very few, uncommon, and probably ecologically unimportant. Perhaps they represent the ancestral stock(s) from which the New Guinean rain-forest forms have evolved.[3]

[3] The following key characterizes 3 species of *Demetrida* from North Queensland, Australia, that are or may be members of the New Guinean radiation of the genus. *D. angulata*, described in the present paper, is the only species known to be common to Australia and New Guinea. The other 2 Australian species named in the key are distinguished by 1-punctate 3rd intervals from all known New Guinean species except *tenuis*.

KEY TO CERTAIN AUSTRALIAN *DEMETRIDA*

1. Elytral apices sinuate-truncate; 3rd intervals 1-punctate 2
– Elytral apices obtusely angulate; 3rd intervals 2-punctate (1 ♀, Rocky R. on Cape York; New Guinea) ..... *angulata* (n. sp.)
2. Prothorax with posterior-lateral setae (11, middle Cape York, Cairns, Kuranda, etc., vic. Brisbane, Clarence R.) ..... *longicollis* Macleay

Also, a few Australian *Demetrida* live in long grass, and a few unrelated New Guinean species (perhaps *pallens*?) may have invaded grassland independently, at high altitudes—but this is a guess, based on the insects' appearance; the actual habitats of the New Guinean species in question are not recorded. However, these exceptions and doubts do not change the general fact: *Demetrida* has radiated ± independently in the New Guinean rain forest, and the radiation may be continuing explosively now. The radiation of these beetles parallels in some ways the radiation of birds of paradise in the same forests.

The geographic distribution of different species of *Demetrida* in New Guinea is not yet very well known, and the ecologic distribution of the species within the rain-forest-foliage habitat is hardly known at all. Some species of the genus are apparently localized in parts of New Guinea, and geographic replacement may occur in some cases. But many other species are evidently wide-ranging on the island, and many species sometimes occur together at one locality or in a very limited area. For example, I found 8 species at Dobodura, at relatively low altitudes. And 19 species have been found at or near Wau on the Morobe Plateau, at mid-altitudes. The genus as a whole ranges in New Guinea from sea level to or above timber line but is evidently best represented at mid-altitudes, where it is apparently dominant, and where most of the strikingly colored species occur. Some species are evidently confined to or specially characteristic of either low, middle, or high altitudes, and related species may replace each other at different altitudes in some cases.

Prothorax without posterior-lateral setae	3
3. Prothorax narrower (width/length 0.84 and 0.93); front subcarinate (New Guinea only)	(*tenuis* n. sp.)
– Prothorax wider (width/length 1.07); front not subcarinate (1 ♀, Cairns)	*ferruginea* Chaudoir

As to their ecology, the bright color of some New Guinean *Demetrida* and the fewness of individuals taken at light suggest that most species are diurnal. How the various species that occur together, for example at Wau, divide the niches within the rain-forest-foliage habitat can only be guessed at now. A few *may* have become nocturnal. Some species certainly live in understory vegetation in the rain forest, but some *may* live at mid-levels and some *may* live in the actual tree tops. Different species *may* specialize in narrower habitats, or they *may* specialize in different kinds or sizes of prey. But I should repeat that this is mainly guesswork. There is an opportunity here for exciting work in the field, on the ecologic radiation of a dominant group of insects that is radiating structurally.

Some New Guinean *Demetrida* may be mimics. Evolution of mimetic relationships would, I think, be consistent with the genus being now in the midst of an evolutionary explosion, with many species genetically variable, ready to respond to special selection pressures. *Demetrida imitatrix* resembles and may mimic the common New Guinean carabid *Violagonum violaceum* (Chaudoir), and some other brightly colored *Demetrida* may mimic other Carabidae (perhaps certain Colliurini) and other beetles.

An extraordinary circumstance is that, although many species of *Demetrida* occur in New Guinea and although some of them are common (I have examined a total of about 1250 individuals) all 56 New Guinean species seem to be undescribed! However, this should not be interpreted as evidence of evolution within historic times. Most of the common species occur at mid-altitudes in the mountains, where not much carabid collecting was done until Evelyn Cheesman's time, in the 1930's, and where really extensive collections of Carabidae have been made only recently, by Dr. Gressitt, the Sedlaceks, and other Bishop

Museum entomologists. Andrewes, during his work on Oriental Carabidae, did see a few older specimens of *Demetrida* from New Guinea, including one or two of the strikingly colored forms, but he refrained from describing them; he did not know what genus to put them in! So, I think failure of earlier authors to describe New Guinean species of *Demetrida* was a result partly of the inaccessibility of the habitats of most common species, partly of commendable caution on the part of taxonomists including H. E. Andrewes, and probably partly just of chance.

Methods. My specific descriptions in *Demetrida* follow a special, slightly modified form designed to characterize the species adequately without wasting space. Characters covered in the generic *Description* are not repeated, but each specific description begins with a statement that the species shares the generic characters. In addition to the usual proportions, the ratio of width of base of prothorax/width of head is given; it is especially useful in distinguishing some species of *Demetrida*. The headings *Inner wings*, *Lower surface*, and *Legs* are omitted; these subjects are sufficiently covered in the *Description* of the genus. A special heading *Claws* is added because number of claw teeth may prove to be diagnostic of some species.

Secondary sexual characters, especially modifications of the ♂ middle tibiae, have been examined carefully and used in characterizing species. The tibiae are best seen against an illuminated white background. To see a tibia clearly at the proper angle it is often necessary to straighten a middle leg, and this can usually be done without relaxing the specimen, by pulling the tibia straight with a pin point and putting a minute drop of glue on the articulation to hold the straightened tibia in place. However, I have not examined the ♂ copulatory organs. This is a task for third-stage taxonomists, far beyond what I have time to do now (see Part I of my "The Carabid Beetles of New Guinea," Bull. Mus. Comp. Zool. 126, No. 3, pp. 328–330).

In drawing descriptions in this genus I have used "*c.*" (*circa*, meaning approximately) even more often than usual, as a stratagem for saving space where I do not think exact or detailed statements are useful. I have also sometimes used it as a warning that variation probably occurs although my material is too limited to show it.

A statement of my procedure in attacking the particularly difficult problem presented by the New Guinean *Demetrida* may be useful to future taxonomists. My method has been to alternate between the general and the particular, with first a general sorting of individuals into apparent species and preparation of a very preliminary key, then drawing of detailed descriptions species by species to determine characters and variation, then preparation of an improved general classification and an improved key, then further checking of details and variation, and eventually (by a much longer process than this!) preparation of a final key and descriptions emphasizing characters that have proved significant and emphasizing variation, and last of all completion of introductory and explanatory material, including the present statement. This is the general method that taxonomists use in classifying any unknown animals, but the process has been much more complex in *Demetrida* than usual. Specific problems have been numerous and difficult. In some cases I cannot be sure from available material whether differences in color, presence or absence of setae, or length of elytral spines are specific characters, cases of Mendelian dimorphism, or other individual variations. I have had to decide these cases arbitrarily, and my groupings of species are partly arbitrary. The resulting classification is at best an approximation. Of course this is true of most classifications, but I am more than usually conscious of the fact in this case.

The question may be raised, why publish

a classification that is only a doubtful approximation? The answer is that it presents an exciting situation in the only way that it can be presented now. Further work on *Demetrida*, including field work (which is essential), requires some sort of classification. In this and many other cases where a classification is needed, we can only follow what I think is a basic rule of the trade: a taxonomist must do the best he can with the available material in the available time. Actually, this imperfect treatment of *Demetrida* may prove to be the most important part of my taxonomic work on New Guinean Carabidae.

The following *Key to Species of Demetrida of New Guinea* is complicated and at some points difficult to use. This is inevitable in the case of an "exploding" group in which some species are exceptionally variable and others connected by intergrades. The key is designed primarily for identification. It is partly but not wholly phylogenetic: species that are closely grouped in the key are likely to be related but are not necessarily so. A few dimorphic or exceptionally variable species are run out at two different points in the key, but I have had to limit such multiple treatments. A few individuals are therefore unidentifiable by key characters and have to be placed by comparison of specimens. I might be able to construct a multiple-treatment key that would identify every individual variant of each *Demetrida* now known from New Guinea, but the key would be impossibly complex even for present use and it would not take care of new material, which will surely include new variants of many species. The key must be used with care and discretion. Proportions *must* be calculated from measurements. Much variation must be allowed for, more than I have been able to indicate in detail. Alternatives must be tried when specimens do not key out clearly. The test of a key like this is whether it works reasonably well in practice. First-time users will probably find it very difficult. Persons who become more familiar with it will, I hope, find shortcuts, in part suggested by section headings inserted in brackets.

For comparisons of New Guinean *Demetrida* with Australian species see especially Footnote 3 (p. 143) and under *D. prima* (p. 150).

Key to the Species of *Demetrida* of New Guinea

[*Pubescent*]

1. Most of upper surface including sides of head behind eyes plainly pubescent 2
– Surface not pubescent or (*seriata* and *nubicola* only) pubescence very sparse, fine, scarcely detectable 8
2. Pubescence short; elytra truncate or sinuate-truncate at apex 3
– Pubescence long, sparse-pilose; elytra usually lobed or spined at apex (scarcely so in *pallens*) 6
3. Posterior-lateral prothoracic setae present, at basal angles; smaller, length under 7.5 mm (p. 149) ..... *aitape*
– Posterior-lateral prothoracic setae absent; size larger 4
4. Eyes more prominent, head nearly as wide as prothorax (width head/prothorax 0.98 and 0.96); ♀ with 3 (♂ probably 2) apical ventral setae each side; (length *c.* 9 mm) (p. 149) ..... *goroka*
– Eyes less prominent, head relatively narrower; apical ventral setae more numerous 5
5. Color entirely brown; length usually more than 9 mm (p. 150) ..... *prima*
– Bicolored, head and prothorax brown, elytra nearly black; length usually less than 9 mm (p. 151) ..... *nigripennis*
6. Elytral apices sinuate-truncate or weakly lobed; color irregular pale brown (p. 151) ..... *pallens*
– Elytral apices spined 7
7. Brown, elytra with pale speckles (p. 151) ..... *tesselata*
– Almost black, elytra faintly or not speckled (p. 152) ..... *crepera*

[*Elytra truncate*]

8. Elytral apices obliquely truncate or sinuate-truncate (Figs. 97, 99) 9
– Elytral apices angulate, toothed, spined, or at least subangulately lobed (Fig. 102) *c.* opposite ends of 2nd striae or 2nd intervals 15
9. Third and usually 5th elytral intervals each with several seta-bearing punctures; upper surface with a little sparse, fine, scarcely detectable pubescence 10

– Third intervals with 1 or 2 and 5th intervals without seta-bearing punctures; upper surface without such pubescence; (color brown) 11

10. Color entirely brown (p. 153) ..... *seriata*
– Bicolored, reddish brown with base of elytra black; (see also *Description*) (p. 153) ..... *nubicola*

11. Large (over 10 mm) *and* prothorax strongly narrowed in front *and* outer angles of elytra distinct, only slightly blunted (p. 154) ..... *magna*
– *Either* smaller *or* with prothorax differently shaped *or* with outer elytral angles rounded 12

12. Prothorax wider than long at middle (by measurement); posterior-lateral prothoracic setae usually present 13
– Prothorax longer than wide; posterior-lateral prothoracic setae absent 14

13. Larger (7–9.8 mm); outer angles of elytra distinct although sometimes slightly blunted (p. 155) ..... *truncata*
– Smaller (5.6–6.3 mm); outer angles of elytra blunted or rounded (p. 155) ..... *minor*

14. Third elytral intervals 2-punctate; apical ventral setae 3 each side in ♂, probably more in ♀ (p. 156) ..... *subtenuis*
– Third elytral intervals 1-punctate; apical ventral setae 1 each side in ♂, 2 in ♀ (p. 156) ..... *tenuis*

[*Elytra angulate, toothed, or spined*]

15. Pronotum without posterior-lateral seta-bearing punctures 16
– Pronotum with posterior-lateral seta-bearing punctures at or near posterior angles 57

16. Color above brown (testaceous to piceous), reddish, black, or bicolored black-and-paler, but not in any part metallic 17
– Color above partly or wholly metallic blue, blue-black, green, or purple, often but not always bicolored 50

17. Not distinctly bicolored above, usually ± uniform brown, sometimes grading into darker brown or piceous on some parts of body (some doubtful species are run both ways in the key) 18
– Sharply bicolored above, partly brown or reddish, partly (sometimes only broad humeral areas) black 39

18. Genae angulately or roundly prominent; (3rd intervals of elytra 3-punctate) 19
– Genae oblique or weakly rounded, not prominent 20

19. Elytral apices obtusely angulate (p. 157) ..... *tripuncta*
– Elytral apices acutely toothed (p. 158) ..... *genicula*

20. Elytral apices weakly lobed or angulate with the angles blunted, obtuse, or right 21
– Elytral apices acutely dentate or spined 23

21. Prothorax subcordate, wider than head and much wider than long (width/length *c.* 1.35); length 5.5–7.1 mm (p. 158) ..... *latangula*
– Prothorax subquadrate, usually (not always) narrower than head and not or not much wider than long; size larger 22

22. Prothorax slightly narrower (cf. descriptions); ♂ middle tibiae slightly bent-in at apex; length 7.5–8.9 mm; (Papua) (p. 159) ..... *angulata*
– Prothorax slightly wider; ♂ middle tibiae slightly bent-out at apex; length 8.5–9.2 mm; (West N. G.) (p. 159) ..... *reversa*

23. Median impressed line of pronotum fine; (form as Fig. 103, very elongate; length *c.* 10–11 mm) (p. 160) ..... *kokoda*
– Median impressed line of pronotum coarse 24

24. Prothorax at middle usually wider than or equal to width of head, or only slightly narrower 25
– Prothorax much narrower (usually by 1/10 or more) than width of head 33

25. Prothorax more cordate, usually wider (*c.* 1/3 to 1/2 wider than long, with base often wider than head) with sides more rounded and more evenly rounded anteriorly, and with wider margins, *and* 3rd elytral interval with only two dorsal punctures, *and* color entirely brown, *and* length usually less than 7 mm 26
– *Either* prothorax more quadrate and narrower (less than 1/3 wider than long, with base usually narrower than head) with sides often but not always less evenly rounded anteriorly and with narrower margins, *or* 3rd elytral interval with more than two dorsal punctures (additional ones sometimes smaller than the 2 primary ones), *or* color darker (at least partly blackish), *or* size larger 27

26. Elytral apices spined (p. 160) ..... *moda*
– Elytral apices acutely angulate or short-toothed (p. 161) ..... *submoda*

27. Prothorax with wider margins, ± cordate 28
– Prothorax with narrower margins, quadrate or more narrowly cordate 31

28. Smaller, length less than 8 mm 29
– Larger, length 8 mm or more 30

29. Eyes more prominent; base of pronotum less punctate; elytra usually with (sometimes faint) reticulate microsculpture (p. 162) ..... *hollandia*
– Eyes less prominent; base of pronotum more punctate; elytra without reticulate microsculpture (p. 162) ..... *wau*

30. Third elytral interval 2-punctate (p. 163) ... *similis*
– Third elytral interval with more than two punctures (p. 164) ... *duplicata*
31. Smaller, length 6.7–7.6 mm; ± piceous; base of prothorax more punctate; 3rd elytral intervals with more than two punctures (p. 164) ... *subpunctata*
– Larger, length 7.7–9.2 mm; brown; base of prothorax less punctate; 3rd elytral intervals 2-punctate ... 32
32. Male middle tibiae tuberculate-serrate; length 7.7–9.2 mm (p. 165) ... *dobodura*
– Male middle tibiae not tuberculate-serrate; length *c.* 10.8 mm (p. 166) *kiunga*

[*Prothorax much narrower than head*]

33. Elytral 3rd intervals 2-punctate, *and* color reddish brown with legs pale except knees sometimes dark, *and* length not over 10 mm ... 34
– Elytral 3rd intervals 3-punctate, *or* (*if* 3rd interval 2-punctate) color in part darker with legs partly or wholly dark, *or* size over 10 mm ... 36
34. Most of upper surface distinctly microreticulate (p. 166) ... *mafulu*
– Microreticulation distinct (if at all) only on elytra ... 35
35. Male middle tibiae tuberculate-serrate; sides of prothorax usually more rounded-in at apex (p. 167) ... *forma*
– Male middle tibiae bent-in at apex but not tuberculate-serrate; sides of prothorax usually almost straight anteriorly (p. 167) ... *recta*
36. Very large, length 10.2–11.4 mm, *and* basal angles of prothorax very prominent (Fig. 105) (p. 168) ... *rex*
– Smaller; basal angles of prothorax usually less prominent ... 37
37. Legs red or brown, not darker than disc of elytra (p. 169) ... *brunnea*
– Legs partly or wholly dark ... 38
38. Third intervals of elytra usually 3-punctate; pronotum without reticulate microsculpture (p. 169) ... *fumipes*
– Third intervals usually 2-punctate; pronotum (lightly) microreticulate (p. 170) *velata*

[*Bicolored but not metallic*]

39. Head and pronotum reddish, elytra entirely dark or with only apices slightly reddish ... 40
– Pattern not as described; elytra usually (not always) bicolored ... 42
40. Elytral striae very lightly impressed; legs black (p. 171) ... *nigripes*
– Elytral striae well impressed; legs usually paler ... 41
41. Elytra usually with reticulate microsculpture (p. 162) ... *hollandia*
– Elytra without reticulate microsculpture (see also couplet 29) (p. 162) ... *wau*
42. Prothorax wider (*c.* ⅕ or more wider than long) ... 43
– Prothorax narrower (*c.* long or longer than wide) ... 44
43. Elytra black with large common discal area red (p. 171) ... *dorsalis*
– Elytra reddish brown with dark base (western N. G.; for individuals from central and eastern N. G. see *Notes* under *duplicata*, p. 164) (p. 172) ... *basalis*
44. Elytral apices angulate; (color diverse, see *Description*) (p. 172) ... *diversa*
– Elytral apices spined (spines sometimes short) ... 45
45. Eyes abrupt (Fig. 107); (anterior angles of prothorax more rounded than usual) (p. 173) ... *vigil*
– Eyes normal, prominent but less abrupt ... 46
46. Head and pronotum black or piceous, or at least darker than elytral disc ... 47
– Head and pronotum red or brown ... 48
47. Elytra wholly brown, long-spined (p. 174) ... *nigriceps*
– Elytra brown with darker humeri, shorter-spined (p. 174) ... *saidor*
48. Elytra red or brown with base wholly black, except suture sometimes red to base; legs pale, sometimes with dark knees (p. 175) ... *divisa*
– Elytra with only humeri dark; legs dark or bicolored ... 49
49. Dark humeral areas wider, usually including parts of 5th intervals; length 9.3–10.8 mm (p. 175) ... *humeralis*
– Dark humeral areas narrower; length 8.3–9.4 mm (p. 169) *fumipes*

[*Metallic at least in part*]

50. Broad (broadest *Demetrida*); color entirely blue-black (p. 176) ... *imitatrix*
– More slender; color not as described ... 51
51. Head and prothorax red, elytra entirely green except sometimes purplish posteriorly (p. 177) ... *viridipennis*
– Color not as described ... 52
52. Color entirely green, green and black, or green and purple ... 53
– Bicolored, elytra in part red or brown ... 54
53. Larger (9.2–10.8 mm); eyes more abrupt; elytra long-spined (p. 177) ... *lepida*
– Smaller (7.0–9.0 mm); eyes less abrupt; elytra usually shorter-spined (p. 178) *sublepida*
54. Head and pronotum red or brown, not plainly metallic ... 55

– Pronotum and sometimes also head metallic green 56
55. Elytral apices angulate (p. 172) ..... *diversa*
– Elytral apices short-spined (p. 179) ..... *viridibasis*
56. Elytral apices acutely angulate; most of upper surface microreticulate (p. 166) ..... *mafulu*
– Elytral apices long-spined; only elytra (faintly) microreticulate (p. 179) ..... *sibil*

[*Posterior-lateral setae present*]
57. Color brown-piceous (head and pronotum usually darker than elytra); prothoracic margins with extra setae anteriorly (p. 180) ..... *seticollis*
– Color wholly or mainly black, blue-black, or green-black; prothoracic margins without extra setae anteriorly 58
58. Legs red testaceous (p. 181) ..... *pallipes*
– Legs dark 59
59. Elytra black with common discal area red (p. 181) ..... *discoidalis*
– Elytra metallic blue-black or green-black without discal red area 60
60. Elytra short-spined (p. 182) ..... *sedlacekorum*
– Elytra long-spined (p. 182) ..... *brandti*

Demetrida aitape n. sp.

Description. With characters of genus; form nearly as in following species (*goroka*, Fig. 97), slender, eyes prominent, elytral apices obliquely subtruncate; entirely brown; surface short-pubescent, without reticulate microsculpture but sparsely punctulate. *Head* 0.91 and 0.90 width prothorax; eyes moderately prominent, genae shorter and oblique. *Prothorax* narrowly subcordate; width/length 1.10 and 1.13; base/apex 1.36 and 1.34; base/head 0.94 and 0.91; sides broadly rounded in anterior ¾, broadly sinuate before right or slightly acute sometimes minutely blunted posterior angles; margins rather wide in proportion to width of insect, each with seta before middle and at or just before basal angle; basolateral areas slightly depressed and more closely punctate than disc. *Elytra* long; width elytra/prothorax 1.69 and 1.61; apices slightly obliquely sinuate-truncate, with outer angles moderately and sutural angles narrowly rounded; striae deep, subpunctate (or with sides of intervals slightly irregular); 3rd interval with *c.* 4 special seta-bearing punctures (difficult to distinguish amid other punctation). *Claws* with *c.* 6 teeth. *Secondary sexual characters*: ♂ tarsi as genus; ♂ middle tibiae tuberculate-serrate (*c.* 5 small tubercles); ♂ with 3 or 4, ♀ 4 or 5 apical ventral setae each side. *Measurements* (types only): length 5.8–7.2; width 1.8–2.3 mm.

Types. Holotype ♂ (M.C.Z., Type No. 31,439) and 3 paratypes from Aitape, **N-E. N. G.,** Aug. 1944 (Darlington); 6 paratypes, Mt. Lamington, **Papua** (C. T. McNamara, S. Australian Mus.).

Additional material. **Papua**: 1, Dobodura, Mar.–July 1944 (Darlington). **N-E. N. G.**: 1, Erima, Astrolabe Bay, 1896 (Biró). **West N. G.**: 1, Dojo [near Hollandia], Apr. 1958 (G. den Hoed, Louwerens Coll., to Leiden Mus. eventually).

Measured specimens. The ♂ holotype and 1 ♀ paratype.

Notes. The relatively small size and presence of posterior-lateral prothoracic setae distinguish this species from other short-pubescent ones in New Guinea. The individuals listed under *Additional material* are slightly larger than the types and vary slightly in form, but seem to be conspecific. All have setae at the posterior angles of the prothorax as well as before middle, and all are ♀ ♀ with 5 setae each side last ventral segment.

Demetrida goroka n. sp.

Description. With characters of genus; form as in Figure 97, slender, eyes prominent, elytral apices obliquely subtruncate; reddish brown, elytra darker but not black, appendages brown; surface short-pubescent, without reticulate microsculpture but sparsely irregularly punctate. *Head* 0.98 and 0.96 width prothorax; eyes rather abruptly prominent, genae slightly shorter, sinuate-oblique; front flattened, irregularly impressed. *Prothorax* narrowly subcordate; width/length 1.04 and 1.02; base/apex 1.26 and 1.38; base/head 0.86 and 0.91; sides broadly rounded in anterior ¾, broadly

sinuate before sharply acute posterior angles; margins rather wide in proportion to width of insect, each with seta slightly before middle but none at base; basolateral areas irregularly impressed, punctate. *Elytra* long; width elytra/prothorax 1.69 and 1.68; apices slightly obliquely sinuate-truncate, with outer angles blunted or rounded, sutural angles narrowly rounded; striae deep, irregularly subpunctate; 3rd intervals each with 4 special punctures in type, the punctures in part obscured or absent in paratype. *Claws* with 6 or 7 teeth. *Secondary sexual characters*: ♂ unknown; ♀ with 3 apical ventral setae each side in both specimens. *Measurements*: length ± 9.0; width 2.8 mm.

Types. Holotype ♀ (Bishop Mus.) and 1 ♀ paratype (M.C.Z., Type No. 31,440) both from Goroka, **N-E. N. G.,** 1500 m, May 22, 1961 (J. L. & M. Gressitt), taken in light trap.

Notes. D. goroka superficially resembles *prima* and *nigripennis* (below) but has wider head with more prominent eyes, slightly narrower prothorax (with more distinctly lobed base), and only 3 apical ventral setae each side in ♀ (probably only 2 in ♂), while ♀ ♀ of *prima* and *nigripennis* have 5 or 6 such setae each side.

Demetrida prima n. sp.

Description. With characters of genus; form nearly as in preceding species (*goroka*, Fig. 97), slender, but with eyes less prominent than in *goroka*, elytral apices obliquely subtruncate; reddish brown; surface short-pubescent, without reticulate microsculpture but sparsely punctulate. *Head* 0.91 and 0.87 width prothorax; eyes less prominent than usual in genus, genae long-oblique. *Prothorax* narrowly subcordate; width/length 1.03 and 1.08; base/apex 1.24 and 1.11; base/head 0.96 and 0.93; sides weakly arcuate anteriorly, broadly sinuate before right or slightly acute well defined basal angles; margins moderate, each apparently with special seta-bearing puncture near middle of length but not at base (these setae and punctures difficult to distinguish amid general pubescence); basolateral impressions punctate. *Elytra* long; width elytra/prothorax 1.64 and 1.53; apices truncate or weakly sinuate-truncate, witb outer angles moderately and sutural angles more narrowly rounded; striae deep, irregularly punctate; 3rd interval with apparently 2–5 special seta-bearing punctures (sometimes difficult to distinguish amid other punctation). *Claws* with 5 or 6 teeth. *Secondary sexual characters*: ♂ unknown; ♀ with *c.* 5 apical ventral setae each side. *Measurements*: length 9.0–9.8; width 2.8–3.0 mm.

Types. Holotype ♀ (Bishop Mus.) from Wau, Morobe Dist., **N-E. N. G.,** 1200 m, Mar. 23, 1963 (Sedlacek), in mercury vapor light trap. Additional (♀ ♀) paratypes from **N-E. N. G.** as follows: 1, Maprick, 160 m, Dec. 29, 1959–Jan. 17, 1960 (T. C. Maa, now in M.C.Z., Type No. 31,441); 1, Torricelli Mts., Siaute, sea level, Nov. 9–17, 1958 (W. W. Brandt, Bishop Mus.); 1, Mumeng, 600 m, Mar. 9, 1962 (Sedlacek).

Measured specimens. The ♀ holotype and ♀ paratype from Mumeng.

Notes. Among New Guinean *Demetrida*, *prima* should be easily known by form, including form of elytral apices, rather large size, nearly uniform reddish brown color, and short-pubescent surface.

Superficially *prima* resembles some Australian species of *Demetrida*. For example it is somewhat similar in form to *grandis* (Chaudoir) of southern Australia but has shorter antennae, smaller eyes, less prominent genae, prothorax narrower anteriorly with narrower margins, and elytra uniformly brown (not striped as in *grandis*). *D. prima* also somewhat resembles *constricticeps* (Sloane) of southwestern Australia in form and is similar in color, but *prima* has shorter antennae, much less prominent genae, less strongly sinuate sides of prothorax, and differs in other details. And *prima* differs from both the Aus-

tralian species named and from all other Australian species known to me in amount and character of pubescence.

Demetrida nigripennis n. sp.

Description. See Plate 1, figure I; with characters of genus; form, elytral apices, pubescence, punctation, and other asexual characters *c.* same as in preceding species (*prima*), but color brownish red with elytra black or nearly so, and size smaller. *Head* 0.88 and 0.89 width prothorax. *Prothorax*: width/length 1.06 and 1.07; base/apex 1.20 and 1.18; base/head 0.90 and 0.98. *Elytra*: width elytra/prothorax 1.56 and 1.64; 3rd intervals with apparently 1–4 principal seta-bearing punctures (difficult to distinguish). *Secondary sexual characters*: ♂ tarsi as genus; ♂ middle tibiae weakly 2-emarginate on inner edge near apex; ♂ with *c.* 4, ♀ *c.* 6 apical ventral setae each side. *Measurements*: length 8.3–9.0; width 2.5–2.8 mm.

Types. Holotype ♂ (Louwerens Coll., eventually to Leiden Mus.) and 1 ♂ paratype (M.C.Z., Type No. 31,442) from Dojo [near Hollandia], **West N. G.,** Apr. 1958 (G. den Hoed); and 1 ♀ paratype, Hollandia, May 1945 (B. Malkin, U.S.N.M.).

Measured specimens. The ♂ holotype and ♀ paratype.

Notes. This may prove to be a geographic form of the preceding species (*prima*), but more material of both sexes from more localities is needed to clarify the relationship. The form of the ♂ middle tibiae is unique among known members of the genus.

Demetrida pallens n. sp.

Description. See Plate 1, figure II; with characters of genus; eyes prominent, prothorax small, cordate-quadrate, and elytral apices sinuate-subtruncate and usually subangulate *c.* opposite ends 2nd striae; color irregular testaceous brown, elytra irregularly tesselated with small paler spots; surface long-pubescent, without reticulate microsculpture, punctate as described below. *Head* 1.10 and 1.08 width prothorax; eyes prominent, genae short-oblique. *Prothorax*: width/length 1.09 and 1.03; base/apex 1.36 and 1.38; base/head 0.85 and 0.91; side margins moderate, entirely fringed with long setae; disc irregularly sparsely punctate. *Elytra*: width elytra/prothorax 2.07 and 2.17; apices usually as figured, subangulate or weakly lobed (simply sinuate-truncate in 1 specimen), outer angles broadly and sutural angles less broadly rounded; striae moderately impressed, in part slightly interrupted, irregularly subpunctate; intervals all with series of coarse seta-bearing punctures among which special dorsal punctures are not distinguishable. *Claws* with 7 or 8 teeth. *Secondary sexual characters*: ♂ tarsi as genus; ♂ middle tibiae tuberculate-serrate (*c.* 6 small tubercles); ♂ with *c.* 4 apical ventral setae each side; ♀ unknown. *Measurements*: length 8–9; width 2.9–3.3 mm.

Types. Holotype ♂ (Leiden Mus.) and 4 ♂ ♂ paratypes (2 in M.C.Z., Type No. 31,443) all from Moss Forest Camp (Snow Mts.), **West N. G.,** 2800 m, Oct. 9–Nov. 5, 1938 (Toxopeus).

Measured specimens. The ♂ holotype and 1 ♀ paratype.

Notes. This very distinct species occurs at a higher altitude than any other *Demetrida* known to me. The coloration, which superficially resembles that of some high-altitude Agonini (some *Maculagonum*), suggests that the insect lives in grass, although the specimens were taken at "Moss Forest Camp."

The (slight) variation in form of elytral apices is one of many examples of individual variation in this remarkably variable genus.

Demetrida tesselata n. sp.

Description. With characters of genus; form (Fig. 98) *c.* average, with eyes prominent, prothorax small, elytra spined; color irregular dark reddish brown, elytra with

numerous small pale flecks forming rows most conspicuous on (but not confined to) odd intervals, legs pale; surface sparsely long-pubescent, without reticulate microsculpture, irregular but scarcely punctate except for punctures (variable in size) from which hairs rise. *Head* 1.16 and 1.08 width prothorax; eyes prominent, genae nearly as long as eyes, oblique. *Prothorax* small, narrowly cordate-subquadrate; width/length 1.03 and 1.07; base/apex 1.31 and 1.35; base/head 0.81 and 0.88; sides weakly rounded anteriorly, often subangulate near middle of length; side margins moderate, irregularly fringed for entire length with long setae; baso-lateral depressions poorly defined, irregular but scarcely punctate. *Elytra*: width elytra/prothorax 2.28 and 2.23; apices spined, outer angles rounded or obtusely blunted (variable), sutural angles obtusely blunted; striae lightly impressed, in part interrupted or reduced to rows of punctures; intervals flat but irregular, odd intervals with series of seta-bearing punctures of moderate size, each puncture usually on posterior side of a broad low tubercle. *Claws* with *c.* 6–8 teeth. *Secondary sexual characters*: ♂ tarsi as genus; ♂ middle tibiae tuberculate-serrate (*c.* 5 widely spaced small tubercles); ♂ with 3 (or more?), ♀ 5 or 6 apical ventral setae each side. *Measurements*: length 8.7–9.8; width 3.0–3.4 mm.

Types. Holotype ♀ (Bishop Mus.) and 1 ♀ paratype (M.C.Z., Type No. 31,444) from Mt. Kaindi, **N-E. N. G.,** 2350 m, Jan. 10 and June 9, 1962 (Sedlaceks), the paratype taken in mercury vapor light trap; and 1 additional paratype ♂ without head, same locality, 2400 m, Jan. 28, 1963 (Sedlacek); 3 paratypes, Wau, 2400 m, Jan. 9–12, 1962 (Sedlaceks); 2 paratypes, 32 km S. of Wau, Bulldog Rd., 2850 m, May 29–30, 1962 (Sedlacek), light trap.

Additional material. **Papua**: 1, Mt. Tafa, 8500 ft. (*c.* 2600 m), Mar. 1934 (Cheesman). **N-E. N. G.**: 1 ♂, Edie Creek, 14 km SW of Wau, 2000 m, Feb. 13, 1962 (Sedlacek); 1 ♀, Enarotadi, 2000 m, Aug. 1962 (Sedlacek). **West N. G.**: 1 ♂, Swart Valley, W. ridge 1800–2000 m, Nov. 19, 1958 (Gressitt).

Measured specimens. The ♂ from Edie Creek and the ♀ holotype, figures given in this order.

Notes. The specimens before me vary not only in size and color but also in form of outer-apical elytral angles, depth of striae, presence or absence of low rounded tubercles on odd elytral intervals, and in other ways. Some of this variation is surely individual, but some may be geographic. Only additional series from several localities can decide this.

Demetrida crepera n. sp.

Description. Form and characters *c.* as in preceding species (*tesselata*) except color piceous or slightly reddish piceous without distinct pale flecks on elytra. *Head* 1.04 and 1.05 width prothorax. *Prothorax*: width/length 1.08 and 1.06; base/apex 1.30 and 1.25; base/head 0.85 and 0.85. *Elytra*: width elytra/prothorax 2.05 and 2.12; sculpture somewhat variable but in general like that in preceding species (*tesselata*), in which the sculpture varies too. *Secondary sexual characters*: ♂ tarsi as genus; ♂ middle tibiae tuberculate-serrate (*c.* 6 tubercles); ♂ with *c.* 4, ♀ *c.* 6 apical ventral setae each side. *Measurements*: length 9.5–10.4; width 3.1–3.5 mm.

Types. Holotype ♂ (A.M.N.H.) and 6 paratypes (2 in M.C.Z., Type No. 31,445) from N. slope, Mt. Dayman, Maneau Rge., **Papua** (the holotype and 4 paratypes at "No. 4," 2230 m, May 19–June 19, 1953; 1 paratype, same data except June 1–7; 1 paratype same except "No. 5," 1550 m, June 30–July 13) (all specimens collected 1953 by Geoffrey M. Tate).

Additional material. **N-E. N. G.**: 1, "No. 10," Purosa Camp, Okapa area, 1950 m, Sept. 29, 1959; 1, "No. 6," Pengagl Camp, east slopes Mt. Wilhelm, 2770 m, July 3, 1959 (both specimens Sixth Archbold Exp., L. J. Brass, A.M.N.H.).

Measured specimens. The ♂ holotype and 1 ♀ paratype.

Notes. This form is apparently a geographic representative (perhaps eventually to be considered a subspecies) of the preceding species (*tesselata*) but is almost black rather than brown, is not distinctly pale-speckled, is slightly larger, and differs slightly in proportions, especially in having relatively narrower elytra.

All individuals of the type series have moth scales stuck to them, indicating that they were taken in light traps.

Demetrida seriata n. sp.

Description. With characters of genus; form *c.* average, with prominent eyes, subcordate prothorax, elytra with sinuate-truncate apices and usually slightly narrowed toward base; color brown or testaceous; surface not obviously pubescent (actually very sparsely and inconspicuously so); reticulate microsculpture present (faint) only on elytra. *Head* 1.06 and 0.98 (sometimes less) width prothorax; eyes prominent, genae short-oblique, not prominent. *Prothorax* narrowly subcordate; width/length 1.06 and 1.04 (wider in some specimens); base/apex 1.32 and 1.30; base/head 0.87 and 0.87; sides broadly rather weakly arcuate in anterior ¾, broadly sinuate before *c.* right posterior angles; each side with seta before middle and at posterior angle (all specimens) and additional weaker setae directed more to side than upward near anterior angle; most of disc virtually impunctate. *Elytra*: width elytra/prothorax 1.92 and 1.97; apices obliquely sinuate-truncate, with both outer and sutural angles rounded or blunted; striae impressed, scarcely punctulate; intervals convex, irregularly sparsely punctulate, 3rd with usually 6 (sometimes fewer) larger seta-bearing punctures, and 3 or 4 similar punctures usually present on 5th intervals. *Claws* with *c.* 5 teeth. *Secondary sexual characters*: ♂ tarsi as genus; ♂ middle tibiae weakly tuberculate-serrate (*c.* 6 small tubercles widely spaced); ♂ with 3, ♀ 4–6 apical ventral setae each side. *Measurements*: length 5.6–7.6; width 2.0–2.8 mm.

Types. Holotype ♂ (Bishop Mus.) and 4 paratypes (2 in M.C.Z., Type No. 31,446) from Eramboe, 80 km ex Merauke, **West N. G.,** holotype Feb. 1, paratypes Jan. 29, Feb. 5, 1960 (T. C. Maa).

Additional material. **Papua**: 1 ♂, Aroa Estate, W. of Redscar Bay, 1 m, Sept. 29, 1958 (Gressitt); 1 ♀, Bisianumu, E. of Port Moresby, 500 m, Sept. 23, 1955 (Gressitt); 1, Daradae nr. Javarere, Musgrove R., 100 m?, Oct. 2, 1958 (Gressitt); 4, Mt. Lamington, 1300–1500 ft. (*c.* 400–460 m) (C. T. McNamara, S. Australian Mus.).

Measured specimens. The ♂ holotype and 1 ♀ paratype.

Notes. This species is characterized by relatively numerous dorsal elytral seta-bearing punctures. Notable also is presence of a little sparse, inconspicuous pubescence (not visible on sides of head behind eyes) and of several weak outward-directed hairs on margins of prothorax near anterior angles. The species is very distinct and probably ranges over the whole length of New Guinea although it has been found thus far only in two widely separated areas near opposite ends of the island.

Demetrida nubicola n. sp.

Description. See Plate 1, figure III; with characters of genus; head, prothorax, and posterior part of elytra dark red, basal ⅔ of elytra black with black color extending farther back at sides than at suture (suture narrowly red), lower surface red (yellowish on abdomen) with metasterna and contiguous parts of epipleurae dark, femora and outer edges of tibiae dark, tarsi and antennae reddish yellow; not obviously pubescent but with some sparse very inconspicuous hairs; reticulate microsculpture absent. *Head* 1.06 width prothorax; eyes prominent, genae shorter, obliquely rounded into neck; front slightly convex, with 2 impressions anteriorly (as usual in genus) and ir-

regularly slightly impressed at middle. *Prothorax* subquadrate with base slightly broader and apex narrower than usual; width/length 1.03; base/apex 1.48; base/head 0.92; sides weakly arcuate for much of length, subangulate at median-lateral setae, strongly sinuate before slightly acute prominent posterior angles; margins moderate, each with seta-bearing puncture *c.* ⅓ from apex and at basal angle, and with several much finer hairs directed laterally near anterior angles; disc moderately (not strongly) convex, baso-lateral impressions present but irregular, subpunctate. *Elytra*: width elytra/prothorax 2.11; apices sinuate-truncate, outer angles broadly rounded, sutural angles blunted; striae well impressed, finely punctulate; intervals convex, 3rd with *c.* 7 and 5th with 4 or 5 seta-bearing punctures. *Claws* with *c.* 5 teeth. *Secondary sexual characters*: ♂ unknown; ♀ with 4 apical ventral setae each side. *Measurements*: length 7.8; width 2.8 mm.

Type. Holotype ♀ (Leiden Mus.) from Lower Mist Camp [Snow Mts.], **West N. G.,** 1550 m, Jan. 31, 1939 (Toxopeus); the type is unique.

Notes. This distinct species is the only known *Demetrida* that combines unarmed elytral apices with dual (black and red) coloration. The sparse, very inconspicuous pubescence and the extra seta-bearing punctures of 3rd and 5th elytral intervals are noteworthy too. The form of elytral apices and the character of pubescence and setae suggest a relationship with *seriata*, but *nubicola* is specifically distinct not only in color but also in form of prothorax.

Demetrida magna n. sp.

Description. With characters of genus; form large, slender, with large eyes, long-quadrate or trapezoidal prothorax, elytra sinuate-truncate at apex; color entirely reddish brown; surface not pubescent, reticulate microsculpture distinct (and slightly transverse) only on elytra, punctation as described below. *Head* 0.94 and 0.98 width prothorax; eyes prominent, genae short and oblique. *Prothorax* long, subparallel or trapezoidal; width/length 0.98 and 1.00; base/apex 1.46 and 1.58; base/head 1.01 and 1.01; sides broadly arcuate anteriorly, usually broadly sinuate before right or slightly acute usually blunted posterior angles; margins moderate, each with seta at basal angle and before middle; disc faintly or not punctulate except irregularly subpunctate in baso-lateral depressions. *Elytra* long; width elytra/prothorax 1.92 and — (elytra of 2nd specimen too spread for measurement); apices obliquely sinuate-truncate, outer angles well defined (sometimes slightly blunted), sutural angles narrowly rounded or blunted; striae impressed, faintly punctulate; intervals convex, sparsely punctulate, 3rd with 2 seta-bearing punctures (present in all specimens but varying in position). *Claws* with *c.* 7 or 8 teeth. *Secondary sexual characters*: ♂ tarsi as genus; ♂ middle tibiae weakly tuberculate-serrate; ♂ with 3, 4, or 5 (number sometimes unsymmetric), ♀ *c.* 6 apical ventral setae each side. *Measurements*: length 10.3–12.0; width 3.3–4.2 mm.

Types. Holotype ♂ (Bishop Mus.) from Finschhafen, Huon Pen., **N-E. N. G.,** 20–150 m, Apr. 15, 1963 (Sedlacek). Paratypes as follows: **N-E. N. G.**: 2 (♂ ♀), Pindiu, Huon Pen., 870–1300 m, Apr. 20, 21–22, 1963 (Sedlacek, M.C.Z., Type No. 31,447); 1 ♀, Adalbert Mts., Wanuma, 800–1000 m, Oct. 25, 1958 (Gressitt); 1, Markham R., 10 m, Jan. 18, 1961 (Sedlaceks). **Papua**: 1, Kokoda, 1200 ft. (366 m), May 1933 (Cheesman); 1, Owen Stanley Rge., Goilala, Loloipa, Feb. 1–15, 1958 (W. W. Brandt, Bishop Mus.); 1, Mt. Lamington, 1300–1500 ft. (*c.* 400–460 m) (C. T. McNamara, S. Australian Mus.). **West N. G.**: 1 ♂, Guega, W. of Swart Valley, 1200 m, Nov. 15, 1958 (Gressitt).

Measured specimens. The ♂ holotype and ♀ paratype from Adalbert Mts.

Notes. Comparative characters of *magna* are given in the preceding *Key*. The species

appears to be widely distributed at low altitudes in New Guinea, but not common.

Demetrida truncata n. sp.

Description. With characters of genus; form *c.* average, but variable; entirely reddish brown; not pubescent, reticulate microsculpture present (but light and variable) only on elytra, and surface not or not much punctulate. *Head* 0.96 and 0.91 width prothorax; eyes moderately prominent, genae much shorter, oblique. *Prothorax* rather long, variable in shape (narrowly subcordate to trapezoidal); width/length 1.07 and 1.05; base/apex 1.37 and 1.38; base/head 0.95 and 1.02; sides variably arcuate anteriorly, broadly sinuate before right or slightly acute blunted or well defined posterior angles; margins moderate, each usually with seta at or near basal angle and before middle (but see *Notes* below); disc smooth at middle, slightly wrinkled or subpunctate at base and sides. Elytra long; width elytra/prothorax 1.80 and 1.78; apices obliquely sinuate-truncate, outer angles well defined (*c.* right but slightly variable), sutural angles narrowly rounded; striae impressed, punctulate; intervals ± punctulate, often with an irregular row of small punctures near middle each interval, 3rd with 2 dorsal punctures in all specimens. *Claws* with 7 or 8 teeth. *Secondary sexual characters*: ♂ tarsi as genus; ♂ middle tibiae finely tuberculate-serrate (about 9 slight tubercles); ♂ with 3 or 4, ♀ 5 or 6 apical ventral setae each side. *Measurements*: length 7.0–9.8; width 2.5–3.5 mm.

Types. Holotype ♂ (Bishop Mus.) from Wau, Morobe Dist., **N-E. N. G.,** 1150 m, Oct. 16, 1961 (Sedlacek); and paratypes as follows. **N-E. N. G.**: 1 ♂, Wau, Mt. Missim, 880–1050 m, Feb. 8–9, 1963 (Sedlacek); 1 ♀, Busu R., E. of Lae, 100 m, Sept. 14, 1955 (Gressitt); 1 ♀, Finschhafen, Huon Pen., 180 m, Apr. 16, 1963 (Sedlacek); 1 ♂, Torricelli Mts., Mobitei, 750 m, Feb. 28–Mar. 4, 1959 (W. W. Brandt, Bishop Mus.). **West N. G.**: 1 ♀, Hollandia, Nov. 21, 1944 (H. Hoogstraal, M.C.Z.); 1 ♀, Waris, S. of Hollandia, 450–500 m, Aug. 16–23, 1959 (T. C. Maa, Bishop Mus.); 1 ♀, Jutefa Bay, Pim, sea level–100 ft. (30 m), Feb. 1936 (Cheesman); 1 ♂, mountain slope above Bernhard Camp, 750 m, Mar. 1939 (Toxopeus). (Some paratypes in M.C.Z., Type No. 31,448.)

Additional material. **N-E. N. G.**: 1 ♀, Finisterre Rge., Saidor: Aiyawa Village, June 16–23, 1958 (W. W. Brandt, Bishop Mus.). **West N. G.**: 1 teneral ♀, Hollandia, 250 ft. (*c.* 75 m), Nov. 3, 1944 (H. Hoogstraal, M.C.Z.); 1 ♀, Camp 1, Mt. Nok, Waigeu Is., 2500 ft. (*c.* 760 m), May 1938 (Cheesman).

Measured specimens. The ♂ holotype and the ♀ paratype from Busu R.

Notes. This species (if it is all one species) is widely distributed at low altitudes in central and western New Guinea. It is not recorded in Papua and may be replaced there by the following species (*minor*). Much more material from many localities is needed to establish the specific limits and geographic variation of these forms.

Although *truncata* usually has a seta-bearing puncture at or near each posterior prothoracic angle, the individual from Jutefa Bay has a well developed seta on the right but no trace of seta or puncture on the left, and seta and puncture are lacking on both sides in the individual from the Finisterre Range. The types and other specimens listed above vary in other ways the significance of which cannot be determined without more material. For example, the prothorax is narrowly subcordate or subquadrate in most of the types while the individual from Waigeu Is. has the prothorax strikingly trapezoidal, but the extremes are connected by intermediates.

Demetrida minor n. sp.

Description. With characters of genus; form as in *truncata* except outer apical elytral angles *c.* rounded; reddish brown; not pubescent, reticulate microsculpture in-

distinct or lightly indicated on elytra, surface very little punctulate. *Head* 0.89 and 1.02 width prothorax; eyes prominent, genae short and oblique. *Prothorax* quadrate-subcordate; width/length 1.17 and 1.08; base/apex 1.52 and 1.44; base/head 1.03 and 0.97; sides broadly rounded in anterior ¾, broadly sinuate before right-obtuse, slightly blunted basal angles; margins moderate, each with seta at base and before middle (posterior seta-bearing puncture present on both sides in all specimens); disc scarcely punctate. *Elytra*: width elytra/prothorax 1.71 and 2.02; apices obliquely sinuate-truncate, outer angles blunted or rounded, sutural angles narrowly rounded; striae impressed, faintly or not punctulate; intervals sparsely inconspicuously punctulate, 3rd with 2 dorsal punctures. *Claws* with *c.* 5 teeth. *Secondary sexual characters*: ♂ tarsi as genus; ♂ middle tibiae weakly tuberculate-serrate; ♂ with 2, ♀ 4 apical ventral setae each side. *Measurements*: length 5.6–6.3; width 2.0–2.2 mm.

Types. Holotype ♂ (M.C.Z., Type No. 31,449) and 1 ♂ paratype from Dobodura, **Papua**, Mar.–July 1944 (Darlington); and 1 ♀ paratype from Brown R., **Papua**, 5 m, Oct. 23, 1960 (Gressitt).

Measured specimens. The ♂ holotype and ♀ paratype.

Notes. This species is probably related to *truncata* but is smaller, with more rounded outer apical elytral angles and fewer apical ventral setae.

Demetrida subtenuis n. sp.

Description. With characters of genus; form (Fig. 99) *c.* as in *truncata* and *minor* but more slender; reddish brown; not pubescent, reticulate microsculpture at most faintly indicated on elytra, surface not much punctulate. *Head* 1.09 and 1.04 width prothorax; eyes prominent, genae short and oblique, not prominent. *Prothorax* elongate-subquadrate; width/length 0.89 and 0.94; base/apex 1.36 and 1.40; base/head 0.88 and 0.96; sides weakly arcuate in much of length, broadly sinuate well before *c.* right, scarcely blunted basal angles; margins narrow, each with seta-bearing puncture before middle but none at base. *Elytra*: width elytra/prothorax 2.08 and — (elytra of 2nd specimen too spread to measure); apices obliquely sinuate-truncate, with outer angles obtuse and slightly blunted or narrowly rounded and sutural angles blunted; striae impressed, faintly punctulate; intervals slightly punctulate, 3rd with 2 dorsal punctures. *Claws* with 5 or 6 teeth. *Secondary sexual characters*: ♂ tarsi as genus; ♂ middle tibiae ± bent-in and weakly tuberculate-serrate; ♂ with 3 apical ventral setae each side (both sides both specimens); ♀ unknown. *Measurements*: length *c.* 7.0; width *c.* 2.3 mm.

Types. Holotype ♂ (Bishop Mus.) from Wum, Upper Jimmi Valley, **N-E. N. G.**, 840 m, July 17, 1955 (Gressitt); and 1 broken ♂ paratype (M.C.Z., Type No. 31,450), vic. Hollandia, **West N. G.**, July–Sept. 1944 (Darlington).

Notes. D. subtenuis resembles *minor* (above) but is much narrower and lacks posterior-lateral prothoracic setae, which are present in *minor*.

Demetrida tenuis n. sp.

Description. With characters of genus; form (Fig. 100) *c.* as in preceding species (*subtenuis*) but even more slender; brownish red, legs slightly paler; not pubescent, reticulate microsculpture visible (but very light) only on elytra, surface not much punctulate. *Head* 1.09 and 1.07 width prothorax; eyes large, moderately prominent, genae much shorter, oblique but convexly prominent; front carinate at middle anteriorly (all specimens). *Prothorax* elongate-quadrate; width/length 0.84 and 0.93; base/apex 1.21 and 1.19; base/head 0.87 and 0.83; sides very weakly irregularly angulate, very broadly sinuate before right or slightly obtuse but well defined basal angles; margins rather narrow, each with seta-bear-

ing puncture before middle but without posterior seta or puncture; disc faintly punctulate, wrinkled or subpunctate in baso-lateral areas. *Elytra*: width elytra/prothorax 2.36 and 2.32; apices sinuate-truncate, outer and sutural angles ± rounded; striae impressed, punctulate; intervals slightly convex, faintly sparsely punctulate, 3rd with 1 dorsal puncture, *c.* ¼ or less from apex (both sides all examples). *Claws* with *c.* 4 teeth. *Secondary sexual characters*: ♂ tarsi as genus; ♂ middle tibiae tuberculate-serrate (4 tubercles); ♂ with 1, ♀ 2 apical ventral setae each side. *Measurements*: length *c.* 6.0–6.5; width 2.0–2.3 mm.

Types. Holotype ♀ (Bishop Mus.) from Aroa Estate, W. of Redscar Bay, **Papua**, 1 m, Sept. 29, 1958 (Gressitt); and 1 ♀ paratype (M.C.Z., Type No. 31,451) from Owen Stanley Rge., **Papua**, Goilala: Loloipa, Feb. 1–15, 1958 (W. W. Brandt); 1 ♂ paratype, Brown R., 20 km N. of Port Moresby, Apr. 29, 1960 (C. W. O'Brien, Bishop Mus.).

Measured specimens. The ♀ holotype and ♀ paratype.

Notes. D. tenuis is characterized by small size, very narrow form especially of prothorax, carination of front, 1-punctate 3rd elytral intervals, and small number of setae of apical ventral segment. The last three characters are unique among New Guinean *Demetrida*, but some Australian species have 1-punctate 3rd intervals, as indicated in *Notes* under the genus and in Footnote 3 (p. 143).

Demetrida tripuncta n. sp.

Description. With characters of genus; form *c.* average, except genae angulate, elytral apices obtusely angulate; reddish brown; not pubescent, reticulate microsculpture distinct (but light) only on elytra, surface not much punctulate. *Head* 1.06 and 0.94 width prothorax; eyes large, prominent (slightly variable), genae slightly shorter than eyes, subangulately prominent; front flattened and irregularly impressed anteriorly. *Prothorax* subquadrate; width/length 1.04 and 1.06; base/apex 1.28 and 1.14; base/head 0.80 and 0.87; sides broadly irregularly arcuate in *c.* anterior ¾, broadly sinuate before *c.* right but blunted posterior angles; margins moderate, each with seta before middle but none at posterior angle; surface punctate-wrinkled in baso-lateral impressions and margins. *Elytra*: width elytra/prothorax—(elytra spread) and 1.91; apices obtusely angulate, with outer angles right or slightly obtuse, sutural angles obtuse; striae impressed, sometimes finely punctulate; intervals convex, sparsely punctulate, 3rd with 3 dorsal punctures (all specimens). *Claws* with *c.* 6 long teeth and sometimes an additional minute one. *Secondary sexual characters*: ♂ tarsi as genus; ♂ middle tibiae slightly bent-in near apex but not tuberculate-serrate; ♂ with apparently 3, ♀ 6–8 apical ventral setae each side. *Measurements*: length *c.* 8–9; width 3.0–3.3 mm.

Type. Holotype ♀ (M.C.Z., Type No. 31,452) from Hollandia, **West N. G.,** Nov. 21, 1944 (Hoogstraal).

Additional material. **Papua**: 1 ♂, Oriomo Govt. Sta., W. District, Oct. 26–28, 1960 (Gressitt), taken in Malaise trap; 1 ♀, Brown R., 5 m, Oct. 23, 1960 (Gressitt), taken on palm. **N-E. N. G.**: 1 ♀, Bulolo, 730 m, Aug. 15, 1956 (E. J. Ford, Jr., Bishop Mus.), taken in light trap.

Measured specimens. The ♂ from Papua and the ♀ holotype, in this order.

Notes. The subangulate genae distinguish this species from all the preceding ones except *tenuis*, which is very different in many ways (see preceding *Key to Species of Demetrida*).

The four specimens listed above agree in a general way and in such important characters as prominence of genae, 3-punctate 3rd intervals, and obtusely angulate elytral apices, but they are from scattered localities and they differ in many details. The single ♂ is teneral and warped so that width of

elytra cannot be measured, and some other characters are difficult to see. More material is needed to show whether all these specimens really are conspecific.

Demetrida genicula n. sp.

Description. With characters of genus; form (Fig. 101) as in preceding species (*tripuncta*) but elytral apices acutely toothed; reddish brown; not pubescent, reticulate microsculpture distinct (but light) only on elytra, surface not much punctulate. *Head* 1.08 and 1.03 width prothorax; eyes prominent, genae subangulately prominent; front flattened and irregularly slightly impressed anteriorly. *Prothorax* quadrate-subcordate; width/length 0.97 and 1.04; base/apex 1.24 and 1.19; base/head 0.83 and 0.83; sides irregularly weakly arcuate in anterior ¾, strongly sinuate before right or slightly acute slightly blunted posterior angles; margins moderate, each with seta-bearing puncture just before middle but none at base; disc weakly strigulose or subpunctate especially laterally. *Elytra*: width elytra/prothorax 1.89 and 1.98; apices with short spines or acute teeth, outer angles sharply defined, right or slightly acute, sutural angles obtuse; striae impressed, scarcely punctulate; intervals convex, slightly sparsely punctulate, 3rd usually 3-punctate (4-punctate on left side only in individual from above Bernhard Camp). *Claws* with 5 or 6 teeth. *Secondary sexual characters*: ♂ tarsi as genus; ♂ middle tibiae bent-in at apex but not tuberculate-serrate; ♂ with 3 or 4, ♀ 4 or 5 apical ventral setae each side. *Measurements*: length 8.2–9.2; width 2.6–3.0 mm.

Types. Holotype ♂ (U.S.N.M.) from Hollandia, **West N. G.** (J. W. Bongberg); and paratypes as follows. **West N. G.**: 1 ♀, Mountain slope above Bernhard Camp, 100 m, Apr. 1939 (Toxopeus). **N-E. N. G.**: 1 ♀, Wau, Morobe Dist., 1200 m, Oct. 29, 1961 (Sedlacek); 1 ♂, Erima, Astrolabe Bay, 1896 (Biró). **Papua**: 1, Daradae, near Javarere, Musgrove R., 100 m, Oct. 4, 1958 (Gressitt).

Additional material. **N-E. N. G.**: 1 ♀, Tsenga, Upper Jimmi Valley, 1200 m, July 14, 1955 (Gressitt).

Measured specimens. The ♂ holotype and the ♀ paratype from Wau.

Notes. The acutely dentate or short-spined rather than obtusely angulate elytral apices distinguish this from the preceding species (*tripuncta*). More material, especially a good series taken at one time and place, is needed to show whether the difference is in fact specific.

Demetrida latangula n. sp.

Description. With characters of genus; form (Fig. 102) small and moderately broad (in genus); reddish brown; not pubescent, reticulate microsculpture present (sometimes faint, and slightly transverse) only on elytra, surface not much punctulate. *Head* 0.89 and 0.91 width prothorax; eyes prominent, genae short, not prominent; front slightly irregularly impressed or with punctiform impression before middle. *Prothorax* subcordate, wide; width/length 1.35 and 1.35; base/apex 1.38 and 1.39; base/head 0.97 and 0.94; sides broadly rounded anteriorly, sinuate before well defined right (sometimes slightly obtuse or acute) basal angles; margins moderately wide, each with seta before middle but none at base; disc sometimes slightly wrinkled or subpunctate basally and laterally. *Elytra* rather short and broad (in genus); width elytra/prothorax 1.85 and 1.78; apices obtusely angulate, with outer angles obtuse and usually slightly blunted, sutural angles blunted; striae impressed, vaguely or not punctulate; intervals convex, sparsely punctulate, 3rd with 2 dorsal punctures. *Claws* with 3 or 4 teeth (and sometimes a small 5th one). *Secondary sexual characters*: ♂ tarsi as genus; ♂ middle tibiae strongly tuberculate-serrate; ♂ with 2 or 3, ♀ 3 or 4 apical ventral setae each side. *Measurements*: length 5.5–7.1; width 2.3–2.9 mm.

Types. Holotype ♂ (Bishop Mus.) from Bisianumu, E. of Port Moresby, **Papua**, 500 m, Sept. 3, 1959 (T. C. Maa); and

paratypes as follows. **Papua**: 1 ♀, Brown R., E. of Port Moresby, 100 m, June 8, 1955 (Gressitt, now in M.C.Z., Type No. 31,453); 1 ♀, Brown R., May 21, 1956 (E. J. Ford, Jr., Bishop Mus.); 1, Mt. Lamington, 1300–1500 ft. (*c.* 400–460 m) (C. T. McNamara, S. Australian Mus.); 1, Buna Bay (C. T. McNamara, S. Australian Mus.). **N-E. N. G.**: 1 ♀, Huon Pen., Pindiu, Apr. 20, 1963 (Sedlacek). **West N. G.**: 1 ♂, Maffin Bay, Sept. 1944 (E. S. Ross, Cal. Acad.).

Measured specimens. The ♂ holotype and 1 ♀ paratype from Brown R.

Notes. This apparently widely distributed lowland species is characterized by small size, relatively broad form, and obtuse angulation of elytral apices. See preceding *Key to Species of Demetrida* for further differential characters.

Demetrida angulata n. sp.

Description. With characters of genus; form slender-average, with obtusely angulate elytral apices; reddish brown; not pubescent, reticulate microsculpture distinct (light and usually slightly transverse) only on elytra, surface not much punctulate. *Head* 1.07 and 1.08 width prothorax; eyes prominent, genae short, oblique, not prominent. *Prothorax* subquadrate, narrow; width/length 1.01 and 1.04; base/apex 1.40 and 1.31; base/head 0.88 and 0.87; sides weakly irregularly arcuate (sometimes almost parallel) in *c.* anterior ¾, broadly sinuate before ± right but blunted posterior angles; margins moderate, each with seta-bearing puncture before middle but none at base; disc variably wrinkled or subpunctate posteriorly and laterally. *Elytra*: width elytra prothorax 1.88 and 2.08; apices obtusely angulate, outer angles sharply defined but varying from slightly obtuse to acute, sutural angles blunted; striae impressed, usually faintly punctulate; intervals convex, sparsely inconspicuously punctulate, 3rd with 2 dorsal punctures. *Claws* with 5 or 6 teeth. *Secondary sexual characters*: ♂ tarsi as genus; ♂ middle tibiae scarcely modified, slightly bent-in near apex, not distinctly tuberculate-serrate; ♂ with 3 or 4, ♀ 5 or 6 setae each side last ventral segment. *Measurements*: length 7.5–8.9; width 2.5–3.1 mm.

Types. Holotype ♂ (Bishop Mus.) from Brown R., **Papua**, Sept. 30, 1959 (T. C. Maa), taken sweeping; and paratypes as follows (some in M.C.Z., Type No. 31,454). **Papua**: 1 ♀, same data as type except dated Aug. 30, 1959; 1 ♀, Brown R., E. of Port Moresby, 100 m, June 8, 1955 (Gressitt); 1, same locality, Apr. 27, 1960 (C. W. Obrien, Bishop Mus.); 1 ♀, Laloki, nr. Port Moresby, Aug. 30–Sept. 2, 1959 (T. C. Maa, Bishop Mus.); 1 ♀, Kiunga, Fly R., July 11–14, 1957 (W. W. Brandt, Bishop Mus.); 1 ♀, Daradae, nr. Javarere, Musgrove R., 100 m, Oct. 2, 1958 (Gressitt).

Measured specimens. The ♂ holotype and 1st ♀ paratype from Brown River.

Notes. See *Key to Species of Demetrida of New Guinea* for distinguishing characters of *angulata*. It is the only New Guinean *Demetrida* known to occur also in **Australia** (1 ♀, Rocky R., mid-peninsular Cape York). In New Guinea, it has been found only in Papua.

Demetrida reversa n. sp.

Description. With characters of genus; form of preceding species (*angulata*) but slightly less narrow; reddish brown; not pubescent, reticulate microsculpture distinct (and somewhat transverse) only on elytra, but much of surface sparsely punctulate. *Head* 1.03 and 1.07 width prothorax; eyes prominent, genae short and oblique, not prominent. *Prothorax* subquadrate; width/length 1.10 and 1.12; base/apex 1.32 and 1.31; base/head 0.94 and 0.98; sides nearly straight and subparallel or slightly converging anteriorly, subangulate at setae, broadly sinuate before right or slightly acute basal angles; margins moderate, each with seta-bearing puncture at or before middle but none at base; disc slightly irregularly subpunctate at base and laterally. *Elytra*: width elytra/prothorax 1.85 and

1.83; apices angulate (the angles *c.* right, but variable), outer angles right or acute, sharply formed; sutural angles obtuse-blunted; striae impressed, faintly punctulate; intervals sparsely punctulate, 3rd with 2 dorsal punctures. *Claws* with 6 or 7 teeth. *Secondary sexual characters*: ♂ tarsi as genus; ♂ middle tibiae slightly bent *out* near apex, inconspicuously or irregularly tuberculate-serrate (Fig. 162); ♂ with *c.* 3, ♀ *c.* 6 setae each side last ventral segment. *Measurements*: length 8.5–9.2; width 3.0–3.4 mm.

Types. Holotype ♂ (Bishop Mus.) and 7 paratypes (3 in M.C.Z., Type No. 31,455) from Guega, W. of Swart Valley, **West N. G.,** 1200 m, Nov. 14, 15, 1958 (Gressitt), and 1 paratype, Swart Valley, W. Fork, 1300–1350 m, Nov. 17, 1958 (Gressitt).

Measured specimens. The ♂ holotype and 1 ♀ paratype from Guega.

Notes. Among similar species with angulate but not spined elytral apices, this is distinguished by quadrate prothorax, proportions as given, and especially by form of ♂ middle tibiae, slightly bent *outward* at apex. Nevertheless the present species may be closely related to the preceding one (*angulata*), which is known only from Papua (and Australia), while the present one is known only from a restricted area of West New Guinea.

Demetrida kokoda n. sp.

Description. With characters of genus; form as in Figure 103, large, slender; reddish brown; not pubescent, reticulate microsculpture present (light or faint) only on elytra, surface not much punctulate. *Head* 0.99 and 0.99 width prothorax; eyes slightly smaller than usual but prominent, genae scarcely distinct from neck. *Prothorax* cordate-subquadrate; width/length 1.11 and 1.12; base/apex 1.22 and 1.23; base/head 0.84 and 0.87; sides strongly rounded in anterior ⅔, strongly sinuate before *c.* right or slightly acute but blunted posterior angles; margins narrow, each with seta slightly before middle but none at base; disc with middle line finer than usual in genus, baso-lateral areas slightly punctate. *Elytra* very long; width elytra/prothorax 1.72 and *c.* 1.86 (elytra spread); apices with moderate spines, outer angles *c.* right or slightly acute, sharply formed, sutural angles slightly obtuse, sometimes denticulate; striae impressed, punctulate; intervals only slightly convex, scarcely punctulate, 3rd with 2 seta-bearing punctures. *Claws* with 7 or 8 teeth. *Secondary sexual characters*: ♂ tarsi as genus; ♂ middle tibiae weakly tuberculate-serrate; ♂ with *c.* 4, ♀ numerous (up to 9) apical ventral setae each side. *Measurements*: length *c.* 10.0–11.0; width 2.9–3.5 mm.

Types. Holotype ♂ (British Mus.) and 5 paratypes (2 in M.C.Z., Type No. 31,456) from Kokoda, **Papua**, 1200 ft. (366 m), May, Aug. (holotype), Sept., Oct., 1933 (Cheesman); 1 paratype, Popondetta, **Papua**, 25 m, June 1966 (Shanahan-Lippert, Bishop Mus.).

Additional material. **N-E. N. G.**: 1 ♀, Wau, Morobe Dist., 1050 m, Apr. 30, 1962 (Sedlacek). **West N. G.**: 1 ♀, Waris, S. of Hollandia, 450–500 m, Aug. 24–31, 1959 (T. C. Maa, Bishop Mus.); 1 ♀, Hollandia, Jan. 1945 (B. Malkin, U.S.N.M.).

Measured specimens. The ♂ holotype and 1 ♀ paratype.

Notes. The form of this species is unique in the genus, so far as I know, and other characters including the relatively fine middle line of the pronotum are distinctive.

Demetrida moda n. sp.

Description. See Plate 1, figure IV; with characters of genus; reddish brown; not pubescent, reticulate microsculpture distinct (but light) only on elytra, parts of upper surface sparsely punctulate. *Head* 0.85 and 0.84 width prothorax; eyes prominent, genae short, oblique, not prominent. *Prothorax* subcordate; width/length 1.46 and 1.33; base/apex 1.40 and 1.37; base/head 1.02 and 1.04; sides arcuate anteriorly, strongly sinuate before sharply defined right or acute posterior angles; margins moderate,

each with seta before middle but none at base; disc slightly punctate basally. *Elytra*: width elytra/prothorax 1.69 and 1.77; apices with moderate spines, outer angles obtuse, sutural angles obtuse; striae impressed, faintly punctulate; 3rd intervals 2-punctate. *Claws* with *c.* 4 teeth. *Secondary sexual characters*: ♂ tarsi as genus; ♂ middle tibiae strongly tuberculate-serrate (*c.* 4 rounded tubercles, Fig. 160); ♂ with 2, ♀ 3 apical ventral setae each side (number may vary). *Measurements*: length *c.* 5.5–6.5; width 2.1–2.5 mm.

Types. Holotype ♂ (M.C.Z., Type No. 31,457) and 4 paratypes from Dobodura, **Papua**, Mar.–July 1944 (Darlington), and additional paratypes as follows. **Papua**: 8, Kokoda, 1200 ft. (366 m), Aug., Sept., Oct., 1933 (Cheesman). **N-E. N. G.**: 2, Sattelberg, Huon Gulf, 1899 (Biró).

Additional material. **N-E. N. G.**: 2, Pindiu, Huon Pen. (1 labeled 500–600 m), Apr. 19, 20, 1963 (Sedlacek); 1, Finschhafen, May 7, 1944 (E. S. Ross, Cal. Acad.); 1, Bubia, Sept. 1949 (N. L. H. Krauss, Bishop Mus.).

Measured specimens. The ♂ holotype and 1 ♀ paratype from Dobodura.

Notes. This species, as the name *moda* is intended to suggest, is the first of several generally similar forms which differ among themselves slightly in proportions and color and more significantly in length of elytral spines and punctation of 3rd elytral intervals. Some of these forms may be geographically limited and allopatric and may eventually be considered subspecies. The present species seems to be confined to the eastern half of New Guinea. Its differential characters are given in the preceding *Key to species.*

Demetrida submoda n. sp.

Description. With characters of genus; form of preceding species (*moda*) except elytra acutely toothed, not spined, and proportions slightly different, with head relatively slightly wider and base of prothorax narrower; color, microsculpture, etc. as in *moda.* Head 0.89 and 0.91 width prothorax; eyes prominent, genae short and oblique. *Prothorax* subcordate; width/length 1.40 and 1.37; base/apex 1.43 and 1.45; base/head 0.97 and 0.95; sides rounded anteriorly, strongly sinuate before *c.* right posterior angles; margins rather wide, each with seta near or before middle but none at base; disc slightly irregular or subpunctate basolaterally. *Elytra*: width elytra/prothorax 1.70 and 1.81; apices acutely angulate or denticulate, outer angles obtuse or blunted, sutural angles obtuse; striae impressed, not distinctly punctulate; intervals convex, slightly inconspicuously punctulate, 3rd 2-punctate. *Claws* with *c.* 5 teeth. *Secondary sexual characters*: ♂ tarsi as genus; ♂ middle tibiae tuberculate-serrate (4 tubercles); ♂ with 2, ♀ 3 apical ventral setae each side. *Measurements*: length 6.0–7.0; width 2.3–2.8 mm.

Types. Holotype ♂ (Bishop Mus.) and 17 paratypes (7 in M.C.Z., Type No. 31,458) from Wau and vicinity (including Mt. Missim), Morobe Dist., **N-E. N. G.**, altitudes from 950 to 1400 m, dates in Jan., Feb., May, July, Aug., Sept., Nov., Dec., 1961–1964 (Sedlaceks, T. C. Maa) (holotype, 1250 m, May 3, 1963); and additional paratypes from **N-E. N. G.** as follows: 2, Bulolo, 1065 m, Aug. 15, 16, 1956 (E. J. Ford, Jr., Bishop Mus.); 1, Upper Watut R., 24 km W. Bulolo, 760 m, Mar. 5–6, 1963 (Sedlacek).

Additional material. **N-E. N. G.**: 1, vic. Nadzab, July 1944 (Darlington); 2, Kassem, 48 km E. of Kainantu, 1350 m, Nov. 7, 1959 (T. C. Maa, Bishop Mus.); 1, Kumun, Upper Jimmi Valley, 1000 m, July 13, — (Gressitt); 1, Maprik, 150 m, Dec. 29–Jan. 17, 1960 (T. C. Maa, Bishop Mus.); 1, Eliptamin Vy., 1200–1350 m, July 16–31, 1959 (W. W. Brandt, Bishop Mus.); 1, Goroka, 1550 m, June 19, 1955 (Gressitt), "pigeon peas cane." **West N. G.**: 1, Hollandia, Dec. 15, 1944 (Hoogstraal, M.C.Z.).

Measured specimens. The ♂ holotype and 1 ♀ paratype from Wau.

Notes. This species differs from *moda*

as indicated in the preceding *Description*. It may prove to be only a subspecies of *moda*, and has thus far been found only in the central-eastern part of the north side of New Guinea, chiefly in the lower mountains.

Demetrida hollandia n. sp.

Description. With characters of genus; form *c.* of *moda* and *submoda* (above) but color darker, reddish brown with elytra darker brown or brownish black with apical ¼ or less often paler, the pale apical area varying in distinctness and extent; microsculpture, etc. *c.* as in *moda*, with reticulations faint but usually visible on elytra. *Head* 0.89 and 0.88 width prothorax, eyes prominent, genae short. *Prothorax* subcordate, slightly narrower than in *moda*; width/length 1.32 and 1.31; base/apex 1.36 and 1.34; base/head 0.97 and 0.95; sides slightly irregularly rounded, often subangulate at lateral setae; margins moderately wide, each with seta near or before middle but none at base; surface not or very little punctate. *Elytra*: width elytra/prothorax 1.86 and 1.85; apices short-spined, outer angles obtuse but more distinct than in *moda*, sutural angles blunted; striae impressed, not distinctly punctulate; intervals convex, scarcely punctulate, 3rd with 2 principal punctures and often (not always) with 1 or more intermediate punctures which vary in size and sometimes do and sometimes do not bear setae. *Claws* with *c.* 4 teeth. *Secondary sexual characters*: ♀ tarsi as genus; ♂ middle tibiae strongly tuberculate-serrate (*c.* 4 tubercles); ♂ with 2, ♀ 3 apical ventral setae each side. *Measurements*: length 5.8–7.6; width 2.1–2.9 mm.

Types. Holotype ♂ (M.C.Z., Type No. 31,459) and 33 paratypes from vic. Hollandia, **West N. G.**, July–Sept. 1944 (Darlington).

Additional material. **West N. G.**: 11, Hollandia and vicinity including Cyclops Mts., at low altitudes (not over 500 m), various dates and collectors; 10, Maffin Bay, dates in June, July, Aug., Sept., Oct. 1944 (E. S. Ross, Cal. Acad.); 5, Nabire, S. Geelvink Bay, 5–50 m, Aug. 25–Sept. 5, 1962 (Sedlacek); 1, Wasian (Vogelkop), Sept. 1939 (Wind, M.C.Z.); 1, Fac Fac, June 1939 (Wind, M.C.Z.). **N-E. N. G.**: 33, various localities including Huon Pen.; Torricelli Mts.; Sepik Dist.; Wewak; Lae; Bulolo; Wau. **Papua**: 1 teneral ♂, doubtfully identified, from Bisianumu, E. of Port Moresby, 500 m, Sept. 24, 1955 (Gressitt).

Measured specimens. The ♂ holotype and 1 ♀ paratype.

Notes. D. hollandia seems closely related to *moda* and *submoda* but is distinguished by characters given above. Some of the specimens listed under *Additional material* vary toward *wau* (see below).

Demetrida wau n. sp.

Description. With characters of genus; form *c.* as in *moda*, *submoda*, and *hollandia* but more slender with eyes less prominent and genae slightly longer and less abrupt than in the species named; reddish brown, elytra brownish black, usually not paler at apex; not pubescent, upper surface including elytral disc without reticulate microsculpture but in part (especially elytra) sparsely punctulate. *Head* 0.89 and 0.89 width prothorax; eyes and genae as indicated above. *Prothorax* subcordate; width/length 1.21 and 1.22; base/apex 1.44 and 1.44; base/head 0.99 and 0.99; sides rounded anteriorly, often subangulate at setae (as in *hollandia*), strongly sinuate before *c.* right basal angles; margins rather wide, each with seta near or before middle but none at base; disc more punctate basally and laterally than in the 3 preceding species. *Elytra*: width elytra prothorax 1.73 and 1.73; apices short-spined (or with long acute teeth), with outer angles obtuse but distinct, sutural angles blunted; striae impressed, punctulate; intervals convex, punctulate, 3rd often 4-punctate but intermediate punctures variable in size and sometimes absent and with or without setae. *Claws* with *c.* 5 teeth. *Secondary*

sexual characters: ♂ tarsi as genus; ♂ middle tibiae weakly tuberculate-serrate (*c.* 3 tubercles distinct); ♂ with 2, ♀ 3 apical ventral setae each side. *Measurements*: length 6.4–7.9; width 2.4–2.9 mm.

Types. Holotype ♂ (Bishop Mus.) and 118 paratypes (some in M.C.Z., Type No. 31,460) all from Wau, Morobe Dist., **N-E. N. G.**; altitudes from 1000 to 1450 m; dates in every month, 1961–1963 (holotype, 1200 m, July 22, 1961) (Sedlaceks).

Additional material. **N-E. N. G.**: 9 additional teneral, broken, or atypical specimens from Wau; 1, Jim(m)i R., E. Highlands, July–Sept. 1961 (W. W. Brandt, C.S.I.R.O.); 1, Upper Watut R., 24 km W. Bulolo, 760 m, Mar. 5–6, 1963 (Sedlacek); 1, Erima, Astrolabe Bay, 1897 (Biró). **West N. G.**: 2, Hollandia, May, June 1945 (B. Malkin, U.S.N.M.); 1, Waris, S. of Hollandia, 450–500 m, Aug. 16–23, 1959 (T. C. Maa, Bishop Mus.); 1, Ifar, 400–550 m, June 23, 1959 (T. C. Maa, Bishop Mus.).

Measured specimens. The ♂ holotype and 1 ♀ paratype.

Notes. D. wau may be primarily a geographic representative of *hollandia*, but the long type series seems distinct; the specimens listed above from Hollandia and Waris are plainly *wau*, not *hollandia*; and the one from Ifar seems to be *wau* except that the elytra are distinctly microreticulate. Apparent intermediates do occur at some other localities, however. They are tentatively placed with *Additional material* under *hollandia*. See also *Notes* under *D. subpunctata* (3rd species below).

One ♀ of *wau*, from Wau, is a noteworthy abnormality, with the posterior prothoracic angles irregularly widened and each with 2 setae, although normal individuals of *wau* lack posterior-lateral setae.

Demetrida similis n. sp.

Description. With characters of genus; form of *moda*, etc. but larger, rather slender, with prothorax narrowly subcordate and elytra spined or acutely dentate and with outer angles sharply formed; reddish brown, elytra not or only slightly darker; not pubescent; reticulate microsculpture visible (often faint) only on elytra. *Head* 0.87 and 0.90 width prothorax; eyes prominent, genae shorter, oblique. *Prothorax* subcordate; width/length 1.26 and 1.22; base/apex 1.35 and 1.34; base/head 0.98 and 0.98; sides broadly sometimes slightly irregularly arcuate in more than ¾ of length, strongly sinuate before right or slightly acute usually slightly blunted posterior angles; margins rather wide, each with seta-bearing puncture before middle but none at base; disc slightly punctate at base and sides. *Elytra* long; width elytra/prothorax 1.61 and 1.69; apices short-spined (rarely only acutely toothed), outer angles well formed, varying from slightly obtuse to acute, sutural angles blunted-obtuse; striae impressed, finely punctulate; intervals slightly convex, sparsely finely punctulate, 3rd 2-punctate (all specimens). *Claws* with 6 or 7 teeth. *Secondary sexual characters*: ♂ tarsi as genus; ♂ middle tibiae tuberculate-serrate (*c.* 4 tubercles); ♂ with 2, ♀ 3 or 4 apical ventral setae each side. *Measurements*: length 8.8–10.8; width 3.0–3.5 mm.

Types. Holotype ♂ (M.C.Z., Type No. 31,461) and 3 paratypes from Dobodura, **Papua**, Mar.–July 1944 (Darlington); and additional paratypes as follows. **Papua**: 4, Kokoda, 1200, 1300 ft. (*c.* 366, 400 m), June, Aug., Sept. 1933 (Cheesman), 1 labeled also "In fungus, A, & under bark behind it," and 1 "At light"; 1, same locality, 380 m, Mar. 20, 1956 (Gressitt), in light trap; 2, Kokoda-Pitoki, 400 m, Mar. 23, 1956 (Gressitt); 2, Mt. Lamington, 1300–1500 ft. (*c.* 400–460 m), (C. T. McNamara, S. Australian Mus.).

Additional material. **Papua**: 1, Kiunga, Fly R., Oct. 1–7, 1957 (W. W. Brandt, Bishop Mus.). **N-E. N. G.**: 1, Ebabaang, Mongi Watershed, Huon Pen., 1300–1400 m, Apr. 16–18, 1955 (E. O. Wilson, M.C.Z.).

Measured specimens. The ♂ holotype and 1 ♀ paratype from Dobodura.

Notes. Characters distinguishing this species from *moda*, etc. are given in the *Description*, above; and see also *Notes* under the following species.

Demetrida duplicata n. sp.

Description. With characters of genus; form *c.* as in *similis* (above); reddish brown, elytra not or not much darker; not pubescent, reticulate microsculpture visible only on elytra, more transverse than in *similis*, surface in part sparsely punctulate. *Head* 0.92 and 0.91 width prothorax; eyes prominent, genae shorter, oblique. *Prothorax* quadrate-subcordate; width/length 1.27 and 1.29; base/apex 1.31 and 1.31; base/head 0.94 and 0.96; sides (usually a little irregularly) rounded anteriorly, sinuate before *c.* right but usually blunted posterior angles; margins rather wide, each with seta at or slightly before middle but none at base; disc not much punctate even basally. *Elytra*: width elytra/prothorax 1.71 and 1.75; apices with moderate spines, outer angles sharply defined and sometimes acutely denticulate, sutural angles blunted-obtuse; striae moderately impressed, scarcely punctulate; intervals slightly convex, 3rd with 2 principal and usually one or more smaller intermediate dorsal punctures. *Claws* with *c.* 5 teeth. *Secondary sexual characters*: ♂ tarsi as genus; ♂ middle tibiae tuberculate-serrate (*c.* 6 small tubercles); ♂ with 2, ♀ 3 apical ventral setae each side. *Measurements*: length *c.* 8.0–9.0; width 2.9–3.3 mm.

Types. Holotype ♂ (M.C.Z., Type No. 31,462) and 10 paratypes from Dobodura, **Papua**, Mar.–July 1944 (Darlington); 3 paratypes from Kokoda, **Papua**, 1200 ft. (366 m), Apr., June, Aug. 1933 (Cheesman); 94 paratypes, Mt. Lamington, **Papua**, 1300–1500 ft. (*c.* 400–460 m) (C. T. McNamara, S. Australian Mus.).

Additional material. Sixty-one (including 44 from Wau), from 12 localities, in all 3 political divisions of **New Guinea** (from Milne Bay to mountain slope above Bernhard Camp), altitudes from near sea level to at least 1500 m (at Wau), various dates and collectors.

Measured specimens. The ♂ holotype and 1 ♀ paratype from Dobodura.

Notes. D. duplicata is much like *similis* and occurs at some of the same localities but differs constantly (at least at Dobodura) by having the elytra more distinctly and more transversely microreticulate, with 3rd intervals with more than 2 dorsal punctures. The additional punctures vary in size and sometimes do and sometimes do not bear setae.

At Dobodura, *duplicata* (like *similis*) is uniformly brown, but individuals with base of elytra ± darker occur with brown individuals at many localities including Wau. The color is not obviously dimorphic but apparently continuously variable. A related population in which the elytra are always dark at base occurs in West N. G. (see *basalis*, p. 172). The specimens summarized above under *Additional material* vary in other ways which cannot profitably be discussed in detail here.

Demetrida subpunctata n. sp.

Description. With characters of genus; form *c.* as in *moda*, *wau*, etc., but slightly more slender; dark reddish brown, elytra darker (dark castaneous), legs brown; not pubescent; microsculpture visible (faint, distinctly transverse) only on elytra, but much of upper surface finely sparsely punctulate. *Head* 1.00 and 0.96 width prothorax; eyes moderate, genae slightly shorter, oblique. *Prothorax* narrowly subcordate; width/length 1.16 and 1.16; base apex 1.37 and 1.38; base/head 0.93 and 0.98; sides weakly irregularly arcuate in anterior ¾ or more, strongly sinuate before right or slightly acute posterior angles; margins narrower than in *moda* and *wau*, each with seta before middle but none at base; surface rather closely punctate across base and in margins. *Elytra*: width elytra prothorax 1.88 and 1.88; apices with short spines, outer angles distinct but obtuse and

sometimes slightly blunted, sutural angles blunted or narrowly rounded; striae impressed, faintly punctulate; intervals convex, 3rd usually 3- (rarely 4-) punctate but intermediate puncture(s) variable in size and sometimes indistinguishable. *Claws* with *c.* 4 teeth. *Secondary sexual characters*: ♂ tarsi as genus; ♂ middle tibiae tuberculate-serrate (*c.* 4 rounded tubercles); ♂ with 2, ♀ 3 apical ventral setae each side. *Measurements*: length 6.7–7.6; width 2.3–2.7 mm.

Types. Holotype ♂ (M.C.Z., Type No. 31,463) and 5 paratypes from Dobodura, **Papua**, Mar.–July 1944 (Darlington); and additional paratypes from **Papua** as follows: 7, Kokoda, 1200 ft. (366 m), May, June, July, Aug., Oct. 1933 (Cheesman); 5, Kokoda-Pitoki, 450 m, Mar. 24, 1956 (Gressitt); 1, Bisianumu, E. of Pt. Moresby, 500 m, Sept. 23, 1955 (Gressitt); 1, "Papua," (Hungarian Nat. Mus.); 3, Mt. Lamington, 1300–1500 ft. (*c.* 400–460 m) (C. T. McNamara, S. Australian Mus.).

Measured specimens. The ♂ holotype and 1 ♀ paratype from Dobodura.

Notes. This may (or may not) be the Papuan representative of the *hollandia-wau* group of central and western New Guinea. *D. subpunctata* most resembles *wau* but is slightly more slender, with narrower prothoracic margins (which distinguish it also from *hollandia*), and with distinct elytral microsculpture.

Demetrida dobodura n. sp.

Description. With characters of genus; form *c.* as in *moda* and *similis* but slightly more slender; brown (not dark), elytra not or not much darker; not pubescent, reticulate microsculpture visible (light or faint) only on elytra, surface (except of elytra) not much punctulate. *Head* 0.98 and 0.96 width prothorax; eyes prominent, genae short, oblique. *Prothorax* subquadrate; width/length 1.11 and 1.12; base/apex 1.34 and 1.30; base/head 0.95 and 0.96; sides weakly irregularly arcuate in ¾ or more of length, weakly sinuate before *c.* right but blunted posterior angles; margins narrower than in *moda* and *similis*, each with seta at or slightly before middle but none at base; surface weakly punctate across base and in margins. *Elytra*: width elytra/prothorax 1.88 and 1.87; apices with moderate spines, outer angles acutely denticulate (or right but sharply formed in some individuals listed under *Additional material*), sutural angles blunted-obtuse; striae moderately impressed, finely punctulate; intervals slightly convex, punctulate, 3rd with 2 dorsal punctures. *Claws* with *c.* 5 teeth. *Secondary sexual characters*: ♂ tarsi as genus; ♂ middle tibiae tuberculate-serrate (3 or 4 well spaced small tubercles); ♂ with 2 or 3, ♀ 5 to 7 apical ventral setae each side. *Measurements*: length 7.7–9.2; width 2.6–3.3 mm.

Types. Holotype ♂ (M.C.Z., Type No. 31,464) and 21 paratypes from Dobodura, **Papua**, Mar.–July 1944 (Darlington); and 9 paratypes, Kokoda, **Papua**, 1200 ft. (366 m), Aug., Sept. 1933 (Cheesman).

Additional material. **Papua**: 1, Kiunga, Fly R., Aug. 8–10, 1957 (W. W. Brandt, Bishop Mus.); 1, Koitaki, 1500 ft. (*c.* 450 m), Oct.–Nov. 1928 (Pemberton, H.S.P.A.). **N-E. N. G.**: 1, Pindiu, Huon Pen., 500–600 m, Apr. 19, 1963 (Sedlacek). Also 1 old specimen, ♂, labeled "New Guinea. Sayer," "probably N. gen. near Euproctus," and "Gen. probably near Ctenodactylus" (the last 2 labels probably by Andrewes).

Measured specimens. The ♂ holotype and 1 ♀ paratype from Dobodura.

Notes. Among other brown, spined *Demetrida*, this should be recognizable by prothorax subquadrate *c.* wide as head and slightly wider than long by measurement, by the rather large size, and the 2-punctate 3rd elytral intervals. See also *Notes* under following species (*kiunga*).

The specimens listed under *Additional material* are doubtfully identified. *D. dobodura* is therefore known with certainty only from Dobodura and Kokoda, in Papua.

Demetrida kiunga n. sp.

Description. With characters of genus; form *c.* of preceding (*dobodura*) but larger; reddish brown, elytra slightly but not much darker; not pubescent, reticulate microsculpture distinct only on elytra, surface not much punctulate. *Head* 1.04 and 1.00 width prothorax; eyes moderately prominent, genae shorter and oblique. *Prothorax* subquadrate; width/length 1.00 and 1.02; base/apex 1.31 and 1.24; base/head 0.90 and 0.89; sides very weakly arcuate anteriorly, slightly subangulate at setae, strongly sinuate well before slightly acute sometimes slightly blunted basal angles; margins rather narrow, each with seta at or before middle but none at base; disc slightly irregular or subpunctate at base and in margins. *Elytra* long; width elytra/prothorax 1.87 and 1.80; apices long-spined, outer angles *c.* right and sharply formed but not denticulate, sutural angles obtuse; striae impressed, faintly punctulate; intervals slightly convex, 3rd 2-punctate. *Claws* with *c.* 7 teeth. *Secondary sexual characters*: ♂ tarsi as genus; ♂ middle tibiae unmodified, virtually straight, not tuberculate-serrate; ♂ with 3 or 4, ♀ 4 or 5 (unsymmetric in both individuals) setae each side last ventral segment. *Measurements*: length 10.8; width 3.4 mm.

Types. Holotype ♂ (Bishop Mus.) and 1 ♀ paratype (M.C.Z., Type No. 31,465) from Kiunga, Fly R., **Papua**, Aug. 14–17, 18–23, 1957 (W. W. Brandt).

Notes. Among other plain reddish brown *Demetrida* with quadrate prothorax and spined elytra, this is distinguished by relatively large size, proportions, simple ♂ middle tibiae, and other characters given in the *Key to Species*.

As compared with *dobodura*, the present species is larger, with longer elytral spines but less produced outer elytral angles, as well as with different ♂ tibiae. The single individual of *dobodura* seen from Kiunga is a ♂ with all the characters of *dobodura*: smaller size, denticulate outer elytral angles, and plainly tuberculate-serrate middle tibiae.

Demetrida mafulu n. sp.

Description. See Plate 2, figure V; with characters of genus; color dimorphic, *either* dark red with prothorax and basal ⅔ of elytra green with green color extending farther back at sides than at suture *or* entirely irregular dark reddish brown, legs *either* dark with paler tarsi *or* entirely brown, antennae brown in both cases; not pubescent, reticulate microsculpture present, *c.* isodiametric on head and elytra and transverse on pronotum, surface not much punctulate. *Head* 1.11 and 1.07 width prothorax; eyes prominent, genae shorter, oblique, not prominent; front flattened and irregularly slightly impressed before middle. *Prothorax* subquadrate; width/length 0.96 and 0.99; base/apex 1.35 and 1.35; base/head 0.84 and 0.87; sides weakly arcuate for much of length, scarcely angulate at setae, sinuate before prominent *c.* right basal angles; margins narrow, each with seta-bearing puncture slightly before middle but none at base; disc more convex than usual, baso-lateral impressions irregularly punctate. *Elytra*: width elytra/prothorax 1.96 and 2.03; apices acutely angulate or dentate, outer angles sharply formed, *c.* right or obtuse, sutural angles obtuse; striae well impressed, finely punctulate; intervals slightly convex, faintly sparsely punctulate, 3rd 2-punctate. *Claws* with *c.* 6 teeth. *Secondary sexual characters*: ♂ tarsi as genus; ♂ middle tibiae bent in at apex but not tuberculate-serrate; ♂ with 4, ♀ *c.* 5 apical ventral setae each side. *Measurements*: length 9.3; width 2.9 mm.

Type. Holotype ♂ (British Mus.) from Mafulu, **Papua**, 4000 ft. (1220 m), Dec. 1933 (Cheesman); and 1 ♀ paratype (also British Mus.) with same data except dated Jan. 1934.

Notes. Comparison with *diversa* (p. 172) suggests that the color dimorphism of *mafulu* is simply Mendelian, not sexual. These 2 species may be related, but *mafulu*

seems surely distinct by form, greater convexity of pronotum, and more distinct reticulate microsculpture of much of the upper surface. The 2 individuals of *mafulu* share these characters and, except in color, differ only slightly in other ways: *e.g.*, the ♀ has the elytral apices more acutely toothed but the outer angles more obtuse. The 2 color forms of *mafulu* are keyed out separately in the *Key to Species*.

Demetrida forma n. sp.

Description. With characters of genus; form as in Figure 104; reddish brown, legs testaceous; not pubescent, microsculpture present (weak or faint) only on elytra, surface not much punctulate. *Head* 1.12 and 1.10 width prothorax; eyes prominent, genae short, oblique. *Prothorax* subquadrate, long; width/length 0.99 and 1.01; base apex 1.37 and 1.23; base/head 0.82 and 0.81; sides weakly irregularly rounded through much of length, moderately sinuate posteriorly before *c.* acute but blunted basal angles; margins narrow, each with seta-bearing puncture slightly before middle but none at base; surface in part irregular or weakly punctate posteriorly and laterally. *Elytra* rather long; width elytra/prothorax 2.11 and 2.18; apices spined, outer angles *c.* right, sharply formed, sutural angles right or slightly obtuse, sometimes slightly blunted; striae impressed, weakly punctulate; intervals convex, 3rd with 2 dorsal punctures. *Claws* with 7 or 8 teeth. *Secondary sexual characters*: ♂ tarsi as genus; ♂ middle tibiae tuberculate-serrate (*c.* 3 or more tubercles); ♂ with 2 or 3, ♀ *c.* 4 apical ventral setae each side. *Measurements* (type series): length 9.3–9.6; width 3.1–3.3 mm (specimens listed under *Additional material* 6.8–9.6 mm long).

Types. Holotype ♂ (Bishop Mus.) and 7 paratypes (3 in M.C.Z., Type No. 31,466) all from Pindiu, Huon Pen., **N-E. N. G.**, 500–600, 870–1300 m; dates in Apr. 1963 (holotype, 500–600 m, Apr. 19) (Sedlacek).

Additional material. Twenty-three specimens from 9 localities in **Papua**, **N-E. N. G.**, and eastern **West N. G.** Because of variations (see following *Notes*) and doubtful identifications these specimens are not recorded in detail.

Measured specimens. The ♂ holotype and 1 ♀ paratype.

Notes. Under this species I have tentatively placed all nonpubescent, brown, pale-legged New Guinean *Demetrida* with spined elytra, prothorax elongate-subquadrate and considerably narrower than head (width head/prothorax usually but not always *c.* 1.10 or more), and 3rd intervals 2-punctate (but see below). The specimens thus assembled vary considerably in size, prominence of eyes, exact form of prothorax, and length of elytral spines. Several species may be represented but, if so, I cannot separate them now.

Although the 3rd intervals are 2-punctate on both elytra in most individuals, in 3 cases a 3rd (intermediate) puncture is present on one side only, and an individual from Wau which I tentatively assign to *forma* is 3-punctate on both sides. This individual is the only *forma* (if it is this species) seen from Wau. It is a small ♂ with tuberculate-serrate middle tibiae.

Demetrida recta n. sp.

Description. With characters of genus; form *c.* as preceding species (*forma*) except elytra short-spined; reddish brown, legs pale with dark knees; not pubescent, reticulate microsculpture distinct only on elytra, but surface in part finely sparsely punctulate. *Head* 1.14 and 1.20 width prothorax; eyes prominent, genae shorter, oblique, not prominent (but see *Notes* below). *Prothorax* long-quadrate; width/length 0.92 and 0.88; base/apex 1.28 and 1.28; base/head 0.85 and 0.84; sides virtually straight anteriorly or weakly angulate at setae, sinuate well before slightly acute basal angles; margins narrow, each with seta slightly before middle but none at base; baso-lateral impressions weak, subpunctate.

Elytra: width elytra prothorax 2.14 and 2.30; apices short-spined or acutely toothed, outer angles sharply formed, acute, inner angles obtuse; striae impressed, punctulate; intervals convex, 3rd 2-punctate. *Claws* with *c.* 6 or 7 teeth. *Secondary sexual characters*: ♂ tarsi as genus; ♂ middle tibiae bent in at apex but not tuberculate-serrate; ♂ with 3, ♀ 4 or 5 setae each side last ventral segment. *Measurements*: length 8.4–9.7; width 2.7–3.3 mm.

Types. Holotype ♂ (Bishop Mus.) and 2 ♀ ♀ paratypes (1 in M.C.Z., Type No. 31,467) from Wau, Morobe Dist., **N-E. N. G.**, 1200 (holotype), 1050, and 1090 m, dates in Jan. 1963 (holotype, Jan. 8–10) (Sedlacek).

Additional material. **West N. G.**: 1 ♂, Hollandia, May 1945 (Hoogstraal, M.C.Z.).

Measured specimens. The ♂ holotype and 1 ♀ paratype.

Notes. D. recta resembles *forma* but is distinguished by straighter sides of prothorax and especially by bent-in but not tuberculate-serrate ♂ middle tibiae. *D. recta* may be more closely related to *kiunga* but is smaller, more slender, with shorter elytral spines. The real interrelationships of these and other more or less similar species are doubtful.

This species emphasizes that the ratio base/apex of prothorax must be interpreted with caution. The ratio of 1.28 in *recta* suggests that the apex is considerably narrower than the base, and this is true when the apex is measured in the standard way, between the most advanced points of the angles. Nevertheless, the prothorax appears virtually rectangular.

The genae of the holotype are unsymmetric: the right one is normal, as described above and as in the other specimens of the species, while the left one is subangulate just behind the eye, although not so prominent as in *tripuncta* and *genicula*. This slight angulation of the left gena in one specimen only of *recta* is presumably an abnormality.

Demetrida rex n. sp.

Description. With characters of genus; form as in Figure 105; reddish brown; not pubescent, reticulate microsculpture faint or absent even on elytra, but much of upper surface sparsely inconspicuously punctulate. *Head* 1.06 and 1.08 width prothorax (at middle); eyes prominent, genae shorter, oblique. *Prothorax* trapezoidal, wider at base than at middle; width (at middle)/length 1.06 and 1.02; base/apex 1.41 and 1.34; base/width at middle 1.04 and 1.06; base/head 0.98 and 0.98; sides shaped as figured, narrowly margined, each with seta-bearing puncture at or slightly before middle but none at base; surface irregularly slightly punctate at base and sides. *Elytra* ample; width elytra/prothorax (at middle) 2.00 and 2.12; apices spined, outer angles acutely denticulate, sutural angles obtuse-blunted; striae impressed, punctulate; intervals slightly convex, 3rd with 3 dorsal punctures (all specimens). *Claws* with 7 or 8 teeth. *Secondary sexual characters*: ♂ tarsi as genus; ♂ middle tibiae slightly bent-in toward apex but not tuberculate-serrate; ♂ with 2 or 3, ♀ *c.* 5 apical ventral setae each side. *Measurements*: length 10.2–11.4; width 3.5–4.0 mm.

Types. Holotype ♂ (Bishop Mus.) from Mokai Village, Torricelli Mts., **N-E. N. G.**, 750 m, Dec. 8–15, 1958 (W. W. Brandt); and additional paratypes as follows. **N-E. N. G.**: 1 ♀, Eliptamin Vy., 1200–1350 m, June 19–30, 1959 (W. W. Brandt, Bishop Mus.); 1 ♀, Adalbert Mts., Wanuma, 800–1000 m, Oct. 24, 1958 (Gressitt); 1 ♂, Pindiu, Huon Pen., Apr. 20, 1963 (Sedlacek). **Papua**: 1 ♂, Dogon, Amazon Bay Dist., 2400 ft. (*c.* 730 m), Oct.–Nov. 1962 (W. W. Brandt, C.S.I.R.O.); 1 ♀, Owen Stanley Rge., Goilala, Bome, 1950 m, Apr. 16–30, 1958 (W. W. Brandt, Bishop Mus.). (The paratypes from Adalbert Mts. and Pindiu now in M.C.Z., Type No. 31,468.)

Measured specimens. The ♂ holotype and ♀ paratype from Eliptamin Valley.

Notes. Although the 6 specimens listed

above come from 6 different localities, they seem to be conspecific and to represent a very distinct species, characterized by large size, form of prothorax, presence of an acute tooth (almost a short spine) at outer-apical elytral angle, and 3-punctate 3rd intervals. See *Key to Species* for place of *rex* among other New Guinean *Demetrida*.

Demetrida brunnea n. sp.

Description. With characters of genus; form average, with spined elytra; brownish testaceous, head and prothorax usually slightly darker than elytral disc, legs pale; not pubescent, reticulate microsculpture visible (light) only on elytra, surface not much punctulate. *Head* 1.12 and 1.13 width prothorax; eyes prominent, genae shorter, oblique. *Prothorax* quadrate; width/length 1.02 and 0.99; base/apex 1.23 and 1.26; base/head 0.83 and 0.87; sides subparallel or weakly irregularly arcuate in anterior ¾ or more, subangulate at lateral setae, broadly sinuate before right or slightly acute posterior angles; margins narrow, each with seta at or slightly before middle but none at base; surface irregular or slightly punctate at base and sides. *Elytra*: width elytra/prothorax 2.06 and 2.14; apices spined, outer angles denticulate, sutural angles right or slightly obtuse, slightly blunted; striae impressed, faintly punctulate; intervals slightly convex, 3rd usually 3-punctate. *Claws* with *c.* 6 teeth. *Secondary sexual characters*: ♂ tarsi as genus; ♂ middle tibiae slightly bent in at apex but not tuberculate-serrate (Fig. 161); ♂ with usually 3, ♀ 5 or 6 apical ventral setae each side. *Measurements*: length 8.5–10.0; width 2.9–3.4 mm.

Types. Holotype ♂ (British Mus.) and 8 paratypes (3 in M.C.Z., Type No. 31,469) from Mt. Baduri, Japen Is., **West N. G.,** 1000 ft. (305 m), Aug. 1938 (Cheesman); and the following additional paratypes from **West N. G.**: 1, R. Manai-Undei, Japen Is., 500 ft. (*c.* 150 m), Oct. 1938 (Cheesman); 3, Mt. Lina, Cyclops Mts., 3500–4500 ft. (*c.* 1070–1370 m), Mar. 1936 (Cheesman); 6, Sibil, Star Rge., 1260 m, dates in May, June 1959 (Neth. N. G. Exp., Leiden Mus.), at light; 2, Sibil Vy., Star Mts., 1245 m, Oct. 18–Nov. 8, 1961 (S. Quate, Bishop Mus.); 1, Bivak 36, Star Rge., 1220 m, July 29, 1959 (Neth. N. G. Exp., Leiden Mus.).

Additional material. **N-E. N. G.**: 2, Eliptamin Vy., 1200–1350 m, June 19–30, Aug. 1–15, 1959 (W. W. Brandt, Bishop Mus.); 1, Feramin, 1200–1500 m, June 1–6, 1959 (W. W. Brandt, Bishop Mus.); 1, Pindiu, Huon Pen., 1200–1450 m, Apr. 18, 1963 (Sedlacek). **Papua**: 3, Mafulu, 4000 ft. (*c.* 1220 m), Jan. 1934 (Cheesman); 1, Wakaiuna, Sewa Bay, Normanby Is., Dec. 11–20, 1956 (W. W. Brandt, Bishop Mus.).

Measured specimens. The ♂ holotype and 1 ♀ paratype from Japen Is.

Notes. D. brunnea resembles *forma* in most key characters, but *brunnea* has outer apical elytral angles acutely denticulate (*c.* right in *forma*), 3rd intervals usually 3-punctate (2-punctate in *forma*), and ♂ middle tibiae slightly bent-in but not tuberculate-serrate as in *forma*.

Actually, the punctures of the 3rd intervals vary slightly. Two individuals of *brunnea* (the holotype and the paratype from Bivak 36) have 3 punctures on one and 2 on the other side, although all other *brunnea* listed above are 3-punctate on both sides.

Demetrida fumipes n. sp.

Description. See Plate 2, figure VI; with characters of genus; form slender, with prominent eyes and short-spined elytra; reddish brown, elytra ± paler on disc but with sides behind humeri blackish, legs pale with outer edges of tibiae and apices of femora dark or legs more extensively dark; not pubescent, reticulate microsculpture faint or light even on elytra, surface not much punctulate. *Head* 1.12 and 1.18 width prothorax; eyes prominent, genae shorter and not prominent. *Prothorax* quadrate; width/length 1.05 and 0.99; base/apex 1.21 and 1.17; base/head 0.83 and

0.82; sides almost straight or weakly arcuate in anterior ¾, sinuate before *c.* right but irregular basal angles; margins narrow, each with seta-bearing puncture before middle, none at base; surface scarcely punctate even baso-laterally. *Elytra*: width elytra prothorax 2.07 and 2.26; apices short-spined, outer angles acute, sutural angles slightly blunted; striae impressed, slightly punctulate; intervals slightly convex, faintly sparsely punctulate, 3rd usually 3-punctate. *Claws* with *c.* 5 or 6 teeth. *Secondary sexual characters*: ♂ tarsi as genus; ♂ middle tibiae slightly bent-in at apex but not tuberculate-serrate; ♂ with 2 or 3, ♀ 4–6 apical ventral setae each side. *Measurements*: length 8.3–9.4; width 2.7–3.2 mm.

Types. Holotype ♂ (Bishop Mus.) and 17 paratypes (6 in M.C.Z., Type No. 31,470) all from Wau and vicinity (including Mt. Missim), Morobe Dist., **N-E. N. G.,** altitudes from 1100 to 1500–1900 m, dates in Feb., Mar., Apr., July, Sept., Nov., 1961–1963 (holotype, Wau, 1200–1300 m, Apr. 6, 1963) (Sedlaceks).

Additional material. **Papua**: 3, Doveta, Amazon Bay Dist., 2400 ft. (730 m), Aug. 1962 (W. W. Brandt, C.S.I.R.O.). **N-E. N. G.**: 1 teneral, Wau, 1200 m, Sept. 2, 1961 (Sedlacek).

Measured specimens. The ♂ holotype and 1 ♀ paratype from Wau.

Notes. Among species that are not obviously bicolored, *fumipes* is closest to *forma* but has legs in part darker, sides of elytra behind humeri darker, and 3rd intervals 3-punctate (2-punctate in *forma*). Among bicolored species, *fumipes* is nearest *humeralis* but is smaller, with humeri less extensively black. See also comparative notes under following species.

Demetrida velata n. sp.

Description. With characters of genus; form as in preceding species (*fumipes*); reddish brown, disc of elytra ± paler but sides of elytra narrowly blackish behind humeri, legs in part dark (at least darker than elytral disc); not pubescent, reticulate microsculpture faintly indicated on pronotum and sometimes on part of head and distinct (but light) on elytra, surface not much punctulate. *Head* 1.14 and 1.08 width prothorax; eyes prominent, genae shorter, not prominent. *Prothorax* quadrate, long; width/length 0.94 and 1.00; base/apex 1.21 and 1.34; base/head 0.84 and 0.88; sides weakly irregularly arcuate anteriorly, strongly sinuate before right or slightly acute basal angles; margins narrow, each with seta-bearing puncture before middle but none at base; baso-lateral areas irregularly subpunctate. *Elytra*: width elytra/prothorax 2.05 and 2.16; apices short-spined or acutely toothed, with outer angles ± right and sharply defined, sutural angles obtuse or slightly rounded; striae impressed, faintly punctulate; intervals slightly convex, faintly sparsely punctulate, 3rd usually 2-punctate. *Claws* with 5 or 6 teeth. *Secondary sexual characters*: ♂ tarsi as genus; ♂ middle tibiae tuberculate-serrate (*c.* 6 low tubercles); ♂ with 3 (rarely 4), ♀ *c.* 5 setae each side last ventral segment. *Measurements*: length 8.4–8.8; width 2.7–3.0 mm.

Types. Holotype ♂ (Bishop Mus.) from Saidor, Kiambavi Village, Finisterre Rge., **N-E. N. G.,** July 22–29, 1958 (W. W. Brandt), and 9 paratypes from Finisterre Rge. (3 in M.C.Z., Type No. 31,471) as follows: 1, same data as holotype except Aug. 1–28; 7, Saidor, Matoko (Village), Aug. 29–Sept. 5, Sept. 6–24, 1958 (all collected by W. W. Brandt).

Measured specimens. The ♂ holotype and 1 ♀ paratype from Matoko Village.

Notes. This apparent relative of *forma* is distinguished from the latter by dark elytral edges and dark legs and from *fumipes* by usually 2-punctate rather than 3-punctate 3rd intervals, and *velata* differs from these and from other similar species also in having reticulate microsculpture visible, although faint, on pronotum (and sometimes part of head) as well as elytra. *D. velata* may be more closely related to *diversa* but is less distinctly bicolored and

more distinctly microreticulate, with usually better developed (but still short) elytral spines.

The 3rd intervals are 2-punctate on both sides of all individuals except that an extra (3rd) puncture is present on one side only in two individuals.

One specimen of the type series has moth scales stuck to it and is presumably from light-trap material.

Demetrida nigripes n. sp.

Description. With characters of genus; form as in Figure 106; head and prothorax red, elytra black, legs and antennae extensively dark with pale bases, tarsi paler; not pubescent, reticulate microsculpture virtually absent in ♂, present (moderately transverse) on elytra in ♀, surface not much punctulate. *Head* 0.98 and 0.94 width prothorax; eyes prominent, genae shorter and oblique. *Prothorax* cordate-subquadrate; width/length 1.20 and 1.28; base/apex 1.39 and 1.34; base/head 0.94 and 0.98; sides broadly slightly irregularly arcuate in more than anterior ¾, moderately sinuate before *c.* right posterior angles; margins rather wide, each with seta-bearing puncture slightly before middle but none at base; disc slightly punctate at sides and base. *Elytra* parallel; width elytra/prothorax 1.77 and 1.71; apices with short spines, outer angles well defined but slightly obtuse, sutural angles obtuse-blunted; striae less impressed but more punctulate than usual; intervals slightly or not convex, 3rd with 3 dorsal punctures (middle puncture sometimes doubtful). *Claws* with 5 teeth. *Secondary sexual characters*: ♂ tarsi as genus; ♂ middle tibiae tuberculate-serrate (3 or 4 rounded tubercles); ♂ with 2, ♀ 3 apical ventral setae each side. *Measurements*: length 7.4–7.7; width 2.3–2.7 mm.

Types. Holotype ♂ (Bishop Mus.) from Swart Vy., Karubaka, **N-E. N. G.,** 1350 m, Nov. 18, 1958 (Gressitt); and 1 ♀ paratype (Bishop Mus.), Daradae, nr. Javarere, Musgrove R., **Papua**, 100 m ?, Oct. 2, 1958 (Gressitt).

Notes. Although the 2 specimens listed above are from different localities, they agree in so many ways (in spite of disagreement in a few details) that I feel sure they are conspecific and that they represent an unusually distinct species, characterized by form, color, and relatively light but strongly punctulate elytral striae, as well as by other characters given in the *Key to Species of Demetrida of New Guinea.*

Demetrida dorsalis n. sp.

Description. See Plate 2, figure VII; with characters of genus; black, elytra with large common red area centered behind middle, appendages dark; not pubescent, reticulate microsculpture absent or indistinct, but parts of upper surface (especially elytra) sparsely punctulate. *Head* 0.93 and 0.89 width prothorax; eyes prominent, genae shorter, oblique; front slightly convex, impressed each side anteriorly, slightly punctate at middle. *Prothorax* subcordate; width/length 1.33 and 1.39; base/apex 1.34 and 1.33; base/head 0.95 and 0.96; sides broadly arcuate in more than anterior ¾, strongly sinuate before right or slightly acute posterior angles; margins rather wide, each with seta-bearing puncture at or slightly before middle but none at base; surface slightly punctate at base and sides. *Elytra*: width elytra/prothorax 1.77 and 1.78; apices angulate, the angulations right or slightly acute, outer angles obtuse or narrowly rounded, sutural angles obtuse; striae well impressed, scarcely punctulate; intervals convex, sparsely but distinctly punctulate, 3rd with *c.* 4 dorsal punctures. *Claws* with *c.* 5 teeth. *Secondary sexual characters*: ♂ tarsi as genus (squamae of front tarsi disarranged, but probably in 2 series); ♂ middle tibiae tuberculate-serrate (*c.* 4 low rounded tubercles); ♂ with 2 or 3, ♀ 3 or 4 apical ventral setae each side. *Measurements*: length 6.8–8.2; width 2.7–3.1 mm.

Types. Holotype ♂ (Bishop Mus.) and 7 paratypes (3 in M.C.Z., Type No. 31,472) all from Wau and vicinity (including Mt. Missim and Nami Creek), Morobe Dist., **N-E. N. G.,** altitudes from 1100 to 1650 m, dates in Jan., Feb., Mar., 1962, 1963 (holotype, Wau, 1100 m, Jan. 31, 1963) (Sedlacek).

Measured specimens. The ♂ holotype and 1 ♀ paratype.

Notes. Although known only from a single locality, this species seems a distinct one, characterized by form, color, angulate but not spined elytral apices, and virtual absence of dorsal elytral reticulate microsculpture, as well as by other key characters.

Demetrida basalis n. sp.

Description. With characters of genus; form and most characters of *duplicata* (p. 000); red or brown with base of elytra (sometimes only humeri) black, legs and antennae reddish with part of femora and tibiae usually darker; not pubescent, microsculpture visible (sometimes faint or indistinguishable) only on elytra, surface in part sparsely punctulate. *Head* 0.93 and 1.02 width prothorax; eyes prominent, genae shorter, oblique. *Prothorax* quadrate-subcordate; width/length 1.21 and 1.17; base/apex 1.36 and 1.30; base/head 0.92 and 0.87; sides irregularly arcuate in more than anterior ¾, sometimes subangulate at setae, strongly sinuate before *c.* right or slightly acute sometimes slightly blunted posterior angles; margins moderately wide, each with seta-bearing puncture at or slightly before middle but none at base; disc slightly punctate across base and in margins. *Elytra*: width elytra/prothorax 1.86 and 2.10; apices spined, outer angles ± right and sharply defined, sutural angles slightly obtuse, blunted; striae impressed, scarcely punctulate; intervals slightly convex, slightly punctulate, 3rd with 2 principal and 1 or 2 intermediate smaller dorsal punctures (all specimens). *Claws* with *c.* 5 teeth. *Secondary sexual characters*: ♂ tarsi as genus; ♂ middle tibiae tuberculate-serrate (*c.* 6 small tubercles); ♂ with 2 or 3, ♀ 3 (or more?) apical ventral setae each side. *Measurements*: length 8.4–10.0; width 2.9–3.5 mm.

Types. Holotype ♂ (Bishop Mus.) from Swart Vy., **West N. G.,** W. ridge, 1800–2000 m, Nov. 19, 1958 (Gressitt); and paratypes as follows. **West N. G.**: 4 (2 in M.C.Z., Type No. 31,473), Swart Vy., Karubaka, 1500 m, Nov. 11, 20, 1958 (Gressitt); 2, Wissel Lakes, Kamo Vy., Itouda and Moanemani, 1500–1700 m, Aug. 18, 16, 1962 (Sedlacek); 1, Star Rge., Sibil Vy., 1245 m, Oct. 18–Nov. 8, 1961 (S. Quate, Bishop Mus.); 1, same locality, 1260 m, June 16, 1959 (Neth. N. G. Exp., Leiden Mus.), at light; 1, Star Rge., Bivak 39, 1300 m, June 28, 1959 (Neth. N. G. Exp., Leiden Mus.); 1 teneral, Araucaria Camp, 800 m, Apr. 2, 1939 (Toxopeus).

Additional material. One teneral, Karubaka, 1450 m, Nov. 16, 1958 (Gressitt), light trap.

Measured specimens. The ♂ holotype and 1 ♀ paratype from Karubaka.

Notes. This may be a geographic (western) representative of *duplicata* (p. 164) with elytra black at base rather than entirely reddish brown (but intermediate color forms occur as noted under *duplicata*) and with elytra less distinctly microreticulate. Its place among other similarly bicolored species is indicated in the *Key to Species.*

Demetrida diversa n. sp.

Description. See Plate 2, figure VIII; with characters of genus; form slender, with prominent eyes and acutely angulate or short-spined elytral apices; color diverse, brownish red with either whole base of elytra (except suture) or only humeri either black or green (individual variation), legs either entirely red or almost entirely black (holotype, basal ⅓ of elytra black, legs red); not pubescent, reticulate microsculpture indistinct or light even on elytra, surface not much punctulate. *Head* 1.07 and

1.14 width prothorax; eyes prominent, genae shorter and oblique. *Prothorax* subquadrate or trapezoidal with base varying from narrower than to wider than width at middle; width (at middle)/length 1.04 and 0.95; base/apex 1.39 and 1.46; base/head 0.88 and 0.94; sides weakly irregularly arcuate in *c.* anterior ¾, sinuate before *c.* right or acute but blunted or narrowly rounded posterior angles; margins rather narrow, each with seta-bearing puncture before middle but none at base; surface irregularly punctate basally and in margins. *Elytra*: width elytra/prothorax (at middle) 1.97 and 2.25; apices with slightly obtuse or acute angulations or very short spines, outer angles well defined but varying from slightly obtuse to acute, sutural angles obtuse; striae moderately impressed, slightly punctulate; intervals slightly convex, 3rd usually 2- sometimes 3-punctate (see *Notes*, below). *Claws* with *c.* 5 or 6 teeth. *Secondary sexual characters*: ♂ tarsi as genus; ♂ middle tibiae tuberculate-serrate (*c.* 7 small tubercles); ♂ with 2 or 3, ♀ 4 or more apical ventral setae each side. *Measurements*: length 7.5–9.5; width 2.7–3.3 mm.

Types. Holotype ♂ (Bishop Mus.) and 27 paratypes (some in M.C.Z., Type No. 31,474) all from Wau and vicinity (including Mt. Missim), Morobe Dist., **N-E. N. G.**, altitudes from 1090 to 1700 m, dates in Jan., Feb., Mar., May, June, July, Sept., Oct., Nov. 1961–1963 (holotype, 1250 m, May 3, 1963) (Sedlaceks).

Additional material. **N-E. N. G.**: 3, Eliptamin Vy., 1200–1350, 1665–2530 m, June 23–30, July 1–15, 16–31, 1959 (W. W. Brandt, Bishop Mus.); 1, Korop, Upper Jimmi Vy., 1300 m, July 12, 1955 (Gressitt), in light trap; 1, Swart Vy., Karubaka, 1550 m, Nov. 8, 1958 (Gressitt, No. 3145); 1, Jim(m)i R., E. Highlands, July–Sept. 1961 (W. W. Brandt, C.S.I.R.O.).

Measured specimens. The ♂ holotype and 1 ♀ paratype.

Notes. The series from Wau shows the entire range of variation indicated in the preceding *Description*. Occurrence together of such diverse individuals in what seems to be one population suggests Mendelian dimorphism of color (elytral bases black or green, legs red or black), and exceptional genetic variation of some other characters. The different characters vary independently. For example, leg color is not correlated with color or extent of basal elytral marks. Of the type series, 15 individuals have 2 punctures on each 3rd interval, 4 (including the holotype) have 2 on one side and 3 on the other, and 2 individuals have 3 punctures on each side.

For distinguishing characters of *diversa* see the *Key to Species of Demetrida of New Guinea.*

Demetrida vigil n. sp.

Description. With characters of genus; form as in Figure 107; head and prothorax brownish red, elytra red with basal ⅓ black, antennae red, legs mainly black; not pubescent, reticulate microsculpture faint and irregular even on elytra in ♂ (possibly more distinct in ♀), surface not much punctulate. *Head* 1.03 width prothorax; eyes not larger than usual but exceptionally abruptly prominent, joining neck posteriorly with virtually no genae. *Prothorax* long-quadrate with anterior angles virtually obliterated; width/length 0.99; base/apex 1.39; base/head 0.91; sides weakly arcuate, sinuate before *c.* right basal angles; margins narrow, each with seta-bearing puncture at or slightly before middle (an extra adventitious puncture on left) but none at base; disc very convex, slightly rugulose and punctulate especially in baso-lateral depressions. *Elytra*: width elytra/prothorax 1.92; apices spined, outer angles acute-denticulate, sutural angles obtuse-blunted; striae slightly impressed, faintly punctulate; intervals slightly convex, 3rd 2-punctate. *Claws* with 4 or 5 teeth. *Secondary sexual characters*: ♂ tarsi as genus; ♂ middle tibiae weakly tuberculate-serrate (*c.* 4 low tubercles); ♂ with 3 apical ventral setae

each side; ♀ unknown. *Measurements*: length 7.8; width 2.5 mm.

Type. Holotype ♂ (C.S.I.R.O., Canberra) from Doveta, Amazon Bay Dist., **SE. Papua**, 2400 ft. (*c.* 730 m), Aug. 1962 (W. W. Brandt); the type is unique.

Notes. The eyes, more abruptly prominent than in any other *Demetrida* that I know, distinguish *vigil* from such similarly colored species as *diversa* and *divisa*.

Demetrida nigriceps n. sp.

Description. With characters of genus; form (Fig. 108) *c.* average, with prominent but not abrupt eyes, rather narrow prothorax, and spined elytra; head and prothorax black, elytra entirely brown, appendages brown with antennae darker outwardly; not pubescent, microsculpture indicated (faint and irregular) on elytra only. *Head* 0.96 and 1.01 width prothorax; eyes prominent, genae shorter, oblique. *Prothorax* subquadrate, long, with base sometimes wider than middle; width/length 0.96 and 1.01; base/apex 1.30 and 1.30; base/head 0.89 and 0.85; sides subparallel in anterior ¾, faintly angulate at lateral setae, broadly sinuate before right or slightly acute posterior angles; lateral margins narrow, each with seta-bearing puncture at or slightly before middle but none at base; surface scarcely or slightly punctate in margins. *Elytra*: width elytra/prothorax 2.21 and 2.14; apices spined, outer angles acute and subdenticulate, sutural angles obtuse-blunted; striae slightly impressed, slightly punctulate; intervals scarcely convex, 3rd 2-punctate. *Claws* with 6 or 7 teeth. *Secondary sexual characters*: ♂ tarsi as genus; ♂ middle tibiae not modified (*c.* straight, not tuberculate-serrate, in both specimens); ♂ with 2–4 apical ventral setae each side (holotype, 4 on each side; paratype, 2 on one side, 3 on other); ♀ unknown. *Measurements*: length *c.* 10.0; width 3.2 mm.

Types. Holotype ♂ (Bishop Mus.) and 1 ♂ paratype (M.C.Z., Type No. 31,475) both from Sibil Valley, Star Mts., **West N. G.**, 1245 m, Oct. 18–Nov. 8, 1961 (S. Quate), the holotype at light, the paratype in Malaise trap.

Notes. The unmodified ♂ tibiae distinguish this species among other similar ones, and other differential characters are given in the *Key to Species of Demetrida of New Guinea*.

The sex (♂ ♂) of both specimens has been determined by dissection as well as by examination of the front tarsi.

Demetrida saidor n. sp.

Description. With characters of genus; form slender, with prominent but not abrupt eyes and spined elytra; head and prothorax brownish black, elytra brownish testaceous with humeri and sometimes entire base narrowly black, appendages irregularly dark with paler tarsi; not pubescent, reticulate microsculpture visible (faint or light) only on elytra, surface not much (slightly, finely, sparsely) punctulate. *Head* 1.25 and 1.11 width prothorax; eyes prominent, genae short, oblique. *Prothorax* long-quadrate with relatively wide base; width/length 0.93 and 1.02; base/apex 1.43 and 1.30; base/head 0.85 and 0.88; sides subparallel or slightly arcuate in *c.* anterior ¾, sinuate before usually acute but slightly blunted posterior angles; margins narrow, each with seta-bearing puncture at or slightly before middle but none at base; surface slightly punctate at base and in margins. *Elytra*: width elytra/prothorax 2.28 and 2.17; apices spined, outer angles acute, sharply defined, sutural angles obtuse; striae lightly impressed, punctulate; intervals flat or slightly convex, 3rd 2-punctate (all specimens), the posterior puncture far back. *Claws* with *c.* 6–7 teeth. *Secondary sexual characters*: ♂ tarsi as genus; ♂ middle tibiae not or very little modified, not bent in at apex and not tuberculate-serrate; ♂ with 3, ♀ *c.* 6 apical ventral setae each side. *Measurements*: length 8.6–10.0; width 2.8–3.3 mm.

Types. Holotype ♂ (Bishop Mus.) from

Saidor, Matoko Village, Finisterre Rge., **N-E. N. G.,** Sept. 6–24, 1958 (W. W. Brandt); 1 ♂ paratype (M.C.Z., Type No. 31,476) from Saidor, Kiambavi Village, Aug. 1–28, 1958 (W. W. Brandt); 2 (♂ ♀) paratypes from Sepalakembang, Salawaket Rge., **N-E. N. G.,** 1920 m, Sept. 11–14, 12, 1956 (E. J. Ford, Jr., Bishop Mus.), in light trap.

Additional material. **West N. G.**: 1 teneral ♂, Wissel Lakes, Moanemani, Kamo Vy., 1500 m, Aug. 19, 1962 (Sedlacek).

Measured specimens. The ♂ holotype and the ♀ paratype from Sepalakembang.

Notes. Among more or less similar species (*fumipes, velata, nigriceps*) this is distinguished by combination of polished (not microreticulate) black head and pronotum, black humeri and legs, and simple ♂ middle tibiae.

Demetrida divisa n. sp.

Description. With characters of genus; form *c.* average, with prominent but not abrupt eyes, rather narrow prothorax, spined elytra; red or yellowish with basal ⅓ or ¼ of elytra black, lower surface reddish yellow with metepisterna mainly dark, legs testaceous with dark knees, antennae brown; not pubescent, reticulate microsculpture distinct (light) only on elytra, surface not much punctulate. *Head* 1.14 and 1.11 width prothorax; eyes prominent, genae oblique and shorter than eyes, sometimes slightly convex in profile but not very prominent. *Prothorax* quadrate, long; width/length 0.95 and 0.95; base/apex 1.30 and 1.32; base/head 0.88 and 0.95; sides nearly straight (except subangulate at setae) in more than anterior ¾, sinuate before *c.* right or acute, slightly blunted posterior angles; margins rather narrow, each with seta-bearing puncture before middle but none at base; surface vaguely subpunctate baso-laterally. *Elytra*: width elytra/prothorax 2.05 and—(elytra spread); apices variably spined (spines usually short), outer angles sharply defined, right or acute, sutural angles obtuse; striae impressed, scarcely punctulate; intervals slightly convex, sparsely slightly punctulate, 3rd with 2 or 3 dorsal punctures (see following *Notes*). *Claws* with *c.* 7 teeth. *Secondary sexual characters*: ♂ tarsi as genus; ♂ middle tibiae scarcely modified, at most slightly bent in at apex, not tuberculate-serrate; ♂ with *c.* 4, ♀ 5 or 6 apical ventral setae each side. *Measurements*: length 9.5–11.5; width 3.1–3.9 mm.

Types. Holotype ♂ (Bishop Mus.) and 1 ♂ paratype (M.C.Z., Type No. 31,477) from Tsenga, Upper Jimmi Vy., **N-E. N. G.,** 1200 m, July 14, 1955 (Gressitt); and additional paratypes as follows. **N-E. N. G.**: 2, Wau, Morobe Dist., 1200 m, Sept. 27, 1961, May 1–15, 1962 (Sedlacek), in light trap; 5, Okapa (Hornabrook); 1, Swart Vy., Karubaka, 1300 m, Nov. 7, 1958 (Gressitt); 1, Sattelberg (British Mus.); **Papua**: 1, Kokoda, 1200 ft. (366 m), May 1933 (Cheesman); 2, Dogon, Amazon Bay Dist., 2400 ft. (*c.* 730 m), Sept., Oct.–Nov. 1962 (W. W. Brandt, C.S.I.R.O.). **West N. G.**: 1 ♀, Bomberi, Vogelkop, 700–900 m, June 5, 1959 (Gressitt).

Measured specimens. The ♂ holotype and ♀ paratype from Sattelberg.

Notes. D. divisa resembles one of the color forms of *diversa*, but *divisa* is larger, with elytra at least short-spined and ♂ middle tibiae not tuberculate-serrate as in *diversa.*

In the ♂ holotype and ♂ paratype from Tsenga and also the ♀ from Bomberi the 3rd intervals are 2-punctate; in all other specimens, 3-punctate; but I find no other characters to suggest that this is a specific difference.

The specimen from Sattelberg is labeled by Andrewes, "Genus mihi ignotum."

Demetrida humeralis n. sp.

Description. With characters of genus; form *c.* average, with prominent eyes, quadrate prothorax, and short-spined elytra; reddish brown, humeri black, legs black or bicolored; not pubescent, microsculpture

faint even on elytra, surface not much punctulate. *Head* 1.07 and 1.08 width prothorax; eyes prominent, genae shorter and oblique. *Prothorax* subquadrate with rather broad base; width/length 1.06 and 1.00; base/apex 1.33 and 1.23; base/head 0.89 and 0.90; sides weakly irregularly arcuate, usually subangulate at setae, broadly sinuate before right or slightly acute posterior angles; margins rather narrow, each with seta-bearing puncture at or before middle but none at base; disc subpunctate across base and in margins. *Elytra*: width elytra prothorax 1.99 and 2.16; apices short-spined, outer angles sharply defined, usually denticulate, sutural angles *c.* right or slightly obtuse; striae moderately impressed, faintly punctulate; intervals slightly convex, 3rd usually 3-punctate. *Claws* with 5 or 6 teeth. *Secondary sexual characters*: ♂ tarsi as genus; ♂ middle tibiae scarcely modified, at most slightly bent in at apex but not tuberculate-serrate; ♂ with 3, ♀ *c.* 6 apical ventral setae each side. *Measurements*: length 9.3–10.8; width 3.0–3.5 mm.

Types. Holotype ♂ (Bishop Mus.) and 12 paratypes (some in M.C.Z., Type No. 31,478) all from Swart Vy., Karubaka, **N-E. N. G.,** 1300 to 1600 m, dates in Nov. 1958 (holotype, 1300 m, Nov. 7) (Gressitt).

Additional material. **N-E. N. G.**: 2, Kassem, 48 km E. of Kainantu, 1350 m, Nov. 7, 1959 (T. C. Maa, Bishop Mus.); 1, Tsenga, Upper Jimmi Vy., 1200 m, July 13, 1955 (Gressitt); 1, Jim(m)i R., E. Highlands, July–Sept. 1961 (W. W. Brandt, C.S.I.R.O.). **West N. G.**: 1, Sibil, Star Rge., 1260 m, May 24, 1959 (Neth. N. G. Exp., Leiden Mus.).

Measured specimens. The ♂ holotype and 1 ♀ paratype from Karubaka.

Notes. D. humeralis differs from the preceding species (*divisa*) principally in color, having less black on elytral bases but darker legs. It is close also to *fumipes* but is larger and more heavily marked. The interrelationships of these forms are still not clear.

The 3rd intervals are usually 3-punctate in *humeralis* but are only 2-punctate in the individual from Sibil.

Demetrida imitatrix n. sp.

Description. See Plate 3, figure IX; with characters of genus; relatively wide; dark blue-black with dark appendages; not pubescent, reticulate microsculpture absent or faint, but surface finely sparsely punctulate. *Head* 0.84 and 0.88 width prothorax; eyes prominent, genae much shorter and oblique. *Prothorax* subcordate; width length 1.39 and 1.36; base/apex 1.36 and 1.40; base/head 1.02 and 1.02; sides broadly slightly irregularly rounded anteriorly, strongly sinuate before *c.* right slightly blunted posterior angles; margins moderately wide, each with seta-bearing puncture at or slightly before middle but none at base; disc subpunctate baso-laterally. *Elytra* short and wide; width elytra prothorax 1.74 and 1.80; apices spined, outer angles obtuse or blunted, sutural angles obtusely blunted; striae impressed, slightly or scarcely punctulate; intervals nearly flat or slightly convex, 3rd 2-punctate. *Claws* with 4 or 5 teeth. *Secondary sexual characters*: ♂ tarsi as genus; ♂ middle tibiae with inner edge swollen or thickened before apex, the swollen portion separated from the apex by a broad emargination; ♂ with 2 or 3, ♀ *c.* 4 apical ventral setae each side. *Measurements*: length 7.4–8.5; width 3.0–3.5 mm.

Types. Holotype ♂ (Bishop Mus.) from Karimui, S. of Goroka, **N-E. N. G.,** 1000 m, June 2, 1961 (Gressitt), taken in light trap; and paratypes as follows. **Papua**: 1 broken ♀, Dobodura, Mar.–July 1944 (Darlington) (M.C.Z., Type No. 31,479), taken on a lighted window; 1, Kokoda, 1200 ft. (366 m), Aug. 1933 (Cheesman); 1, Dogon, Amazon Bay Dist., 2400 ft. (*c.* 730 m), Sept. 1962 (W. W. Brandt, C.S.I.R.O.); 1, Misima Is., Nov. 1963 (W. W. Brandt, C.S.I.R.O.). **West N. G.**: 1, Camp 2, Sabron, Cyclops Mts., 2000 ft. (610 m), July 1936 (Cheesman).

Measured specimens. The ♂ holotype and the ♀ paratype from Dogon.

Notes. Among the New Guinean species of *Demetrida*, this one is unique in its broad form and in form of ♂ tibiae. Nevertheless it has the essential characters of *Demetrida* and I do not think it should be separated from that genus, at least not unless the genus as a whole is divided.

Superficially, *D. imitatrix* resembles *Violagonum violaceum* (Chaudoir), which is very common at low altitudes in New Guinea. This may be an example of Batesian mimicry.

Demetrida viridipennis n. sp.

Description. See Plate 3, figure X; with characters of genus; not pubescent; head and prothorax red, elytra bright green usually shading to purple toward apex, appendages reddish yellow; reticulate microsculpture visible (light) only on elytra, but surface in part slightly sparsely punctulate. *Head* 1.08 and 1.11 width prothorax; eyes moderately prominent, genae shorter and oblique, not prominent. *Prothorax* subquadrate; width/length 1.08 and 1.03; base/apex 1.32 and 1.31; base/head 0.88 and 0.86; basal angles *c.* right, *c.* blunted; margins rather narrow, each with seta near or slightly before middle but none at base; disc subpunctate across base and in margins. *Elytra*: width elytra/prothorax 1.99 and 2.17 (latter spread by pin?); apices spined, outer angles sharply defined, *c.* right (somewhat variable), sutural angles obtuse; striae deeply impressed, slightly punctulate; intervals slightly convex, faintly punctulate, 3rd with 2 dorsal punctures. *Claws* with *c.* 5 teeth. *Secondary sexual characters*: ♂ tarsi as genus; ♂ middle tibiae tuberculate-serrate (*c.* 6 low tubercles); ♂ with 2, ♀ 3 setae each side last ventral segment. *Measurements*: length 6.9–8.5; width 2.5–3.1 mm.

Types. Holotype ♂ (Bishop Mus.) from Wau, Morobe Dist., **N-E. N. G.**, 1200–1300 m, Mar. 14, 1963 (Sedlacek); and paratypes (some in M.C.Z., Type No. 31,480) as follows. **N-E. N. G.**: 4, Wau, 1200, 1220–1250, 1300 m, Nov. 12, 1961, Feb. 11, Jan. 23, 1963, Oct. 14, 1965 (Sedlaceks); 1, Bulolo (near Wau), 1005 m, Aug. 25, 1956 (E. J. Ford, Jr., Bishop Mus.); 1, Mt. Missim, 1600–2000 m, Sept. 21–24, 1964 (M. Sedlacek); 1, Karimui, 1080 m, July 14–15, 1963 (Sedlacek); 1, Okapa, Apr. 19, 1965 (Hornabrook); 1, Kainantu, July 9 (Sedlaceks); 1, Wum, Upper Jimmi Valley, 840 m, July 17, 1955 (Gressitt); 1, Finisterre Rge., Saidor, Funyende, 1200 m, Sept. 24–30, 1958 (W. W. Brandt, Bishop Mus.); 1, Adalbert Mts., Wanuma, 800–1000 m, Oct. 26, 1958 (Gressitt). **Papua**: 1, Kokoda, 1200 ft. (366 m), June 1933 (Cheesman); 2, Owen Stanley Rge., Goilala (Loloipa, Nov. 25–Dec. 10, and Tapini, 975 m, Nov. 16–25, 1957) (W. W. Brandt, Bishop Mus.); 1, Mt. Lamington, 1300–1500 ft. (*c.* 400–460 m) (C. T. McNamara, S. Australian Mus.).

Measured specimens. The ♂ holotype and 1 ♀ paratype from Wau.

Notes. Form, color, and deep elytral striae set this distinct species off from all others of the genus known to me. It is evidently widely distributed in at least the eastern half of New Guinea at moderate altitudes.

Demetrida lepida n. sp.

Description. See Plate 3, figure XI; with characters of genus; head and prothorax black, elytra green-purple (variable, often more green toward base and more purple toward apex, sometimes slightly reddish on disc), appendages dark; not pubescent, reticulate microsculpture faint even on elytra, surface not much punctulate. *Head* 1.24 and 1.12 width prothorax; eyes rather abruptly prominent, genae *c.* long as eyes, slightly convex in outline but not very prominent; front wide, irregularly flattened and impressed or subpunctate at middle. *Prothorax* subquadrate; width/length 0.95 and 1.05; base/apex 1.30 and 1.22; base/head 0.74 and 0.77; sides arcuate anteriorly, sinuate before *c.* right but blunted or nar-

rowly rounded posterior angles; margins narrow, each with seta-bearing puncture at or slightly before middle but none at base; disc convex, baso-lateral impressions almost obsolete, surface faintly subpunctate across base and in margins. *Elytra*: width elytra prothorax—(elytra spread) and 1.95; apices long-spined, outer angles acute or denticulate, sutural angles obtuse; striae lightly impressed, lightly punctulate; intervals flat or slightly convex, 3rd 3-punctate. *Claws* with *c.* 7 teeth. *Secondary sexual characters*: ♂ tarsi as genus; ♂ middle tibiae slightly tuberculate-serrate (*c.* 4 spaced tubercles); ♂ with 3, ♀ 4–6 apical ventral setae each side. *Measurements*: length 9.2–10.8; width 3.0–3.3 mm.

Types. Holotype ♀ (Bishop Mus.) and 10 paratypes (some in M.C.Z., Type No. 31,481) from Swart Vy., Karubaka, **N-E. N. G.,** altitudes from 1300 to 1600 m, dates in Nov. 1958 (holotype, 1450 m, Nov. 12) (Gressitt); and additional paratypes as follows. **West N. G.**: 17, Wissel Lakes, Enarotadi, altitudes from 1750 to 1900 m, dates in July, Aug. 1962 (Sedlacek); 1, Wissel Lakes, Itouda, Kamo Vy., 1500–1700 m, Aug. 18, 1962 (Sedlacek); 1, Wissel Lakes, Kamo-Debei div., 1700 m, Aug. 13, 1955 (Gressitt); 1, Lower Mist Camp, 1700 m, Jan. 17, 1939 (Toxopeus). **Papua**: 1, Owen Stanley Rge., Goilala, Loloipa, Feb. 1–15, 1958 (W. W. Brandt, Bishop Mus.).

Measured specimens. A ♂ paratype from Swart Valley and the ♀ holotype.

Notes. The bright color, rather abruptly prominent eyes, and long elytral spines characterize this fine species. It appears to be widely distributed in New Guinea at moderate altitudes. Of the 19 specimens seen, only 3 are ♂ ♂.

Two Karubaka individuals and one from Enarotadi are labeled as taken in light traps.

Demetrida sublepida n. sp.

Description. With characters of genus; form *c.* as in preceding species (*lepida*) but eyes less abruptly prominent and elytral spines shorter; head and prothorax green, elytra green-purple (variable); appendages dark, tarsi paler; not pubescent, reticulate microsculpture visible (faint) only on elytra, surface not much punctulate. *Head* 1.16 and 1.11 width prothorax; eyes prominent but not abrupt, genae shorter and oblique. *Prothorax* subquadrate; width/length 1.01 and 1.03; base/apex 1.20 and 1.18; base/head 0.80 and 0.86; sides weakly slightly irregularly arcuate in more than anterior ¾, usually strongly sinuate before usually acute posterior angles; margins narrow, each with seta-bearing puncture slightly before middle but none at base; baso-lateral impressions subobsolete, disc slightly transversely wrinkled, vaguely subpunctate across base and in margins. *Elytra*: width elytra/prothorax 2.11 and 2.19; apices spined, outer angles *c.* right or obtuse, sutural angles obtuse; striae well impressed, scarcely punctulate; intervals convex, finely sparsely punctulate, 3rd 2-punctate. *Claws* with 5 or 6 teeth. *Secondary sexual characters*: ♂ unknown; ♀ with 3 or 4 apical ventral setae each side last ventral segment. *Measurements*: length 7.0–9.0; width 2.5–3.1 mm.

Types. Holotype ♀ (Bishop Mus.) from Wissel Lakes, Enarotadi, **West N. G.,** 1850 m, Aug. 1, 1962 (Sedlacek); and additional paratypes as follows. **West N. G.**: 7 (some in M.C.Z., Type No. 31,482), Enarotadi, 1750 to 1900 m, dates in July, Aug. 1962 (Sedlacek); 1, Wissel Lakes, Urapura, Kamo Vy., 1530 m, Aug. 11, 1955 (Gressitt). **N-E. N. G.**: 1, Swart Vy., Karubaka, 1300 m, Nov. 7, 1958 (Gressitt); 1, Wau, Morobe Dist., 1300 m, June 15, 1961 (Gressitt), on Pipturus. All specimens are ♀ ♀.

Measured specimens. The ♀ holotype and ♀ paratype from Enarotadi.

Notes. Although perhaps related to the preceding species (*lepida*), *sublepida* differs in a surprising number of characters including less abrupt eyes, head and pronotum green rather than black, elytral spines shorter, elytral striae deeper, claws

with fewer teeth, and size smaller. These species evidently occur together at some localities, and they may be involved in some sort of mimicry.

Demetrida viridibasis n. sp.

Description. With characters of genus; form slender, with ± prominent eyes and short-spined elytra; red, *c.* basal ⅓ of elytra bright green with the green color extending back more at sides than at middle, femora and parts of tibiae dark; not pubescent, reticulate microsculpture usually visible (but light) on front of head and on pronotum as well as on elytra, much of upper surface also sparsely finely punctulate. *Head* 1.05 and 1.02 width prothorax; eyes prominent, genae *c.* long as eyes and slightly convex in outline but not very prominent. *Prothorax* subquadrate, long; width/length 1.00 and 1.09; base/apex 1.25 and 1.23; base/head 0.85 and 0.85; sides nearly straight for much of length except slightly subangulate at setae, broadly sinuate before *c.* right slightly blunted posterior angles; margins narrow, each with seta-bearing puncture slightly before middle but none at base; disc less convex and with more distinct baso-lateral impressions than in *lepida* and *sublepida*, subpunctate across base and in margins. *Elytra* moderately long; width elytra/prothorax 1.98 and 1.86; apices short-spined, outer angles *c.* right, sharply formed, sutural angles obtuse; striae impressed, faintly punctulate; intervals convex, 3rd 3-punctate. *Claws* with *c.* 5 teeth. *Secondary sexual characters*: ♂ see *Notes*, below; ♀ with 5 or more apical ventral setae each side. *Measurements*: length 8.5–10.3; width 2.9–3.5 mm.

Types. Holotype ♀ (C.S.I.R.O., Canberra) from Dogon, Amazon Bay Dist., **SE. Papua**, 2400 ft. (*c.* 730 m), Sept. 1962 (W. W. Brandt); 1 ♀ paratype (C.S.I.R.O.) with same data except collected Oct.–Nov.; 1 ♀ paratype (M.C.Z., Type No. 31,483), Doveta, Amazon Bay Dist., 2400 ft. (*c.* 730 m), Aug. 1962 (W. W. Brandt).

Additional material. **N-E. N. G.**: 3, Swart Vy., Karubaka, 1300, 1500 m, Nov. 7, 11, 20, 1958 (Gressitt); 1, Finisterre Rge., Saidor, Kiambavi Village, Aug. 1–28, 1958 (W. W. Brandt, Bishop Mus.). **West N. G.**: 1, Cyclops Mts., 3400–4500 ft. (*c.* 1040–1370 m), Mar. 1936 (Cheesman).

Measured specimens. The ♀ holotype and ♀ paratype from Doveta.

Notes. This species seems close to the green-marked form of *diversa* but has longer elytral spines. Some specimens listed under *Additional material* are doubtfully identified. Most are ♀ ♀; the only ♂, from Swart Vy., has middle tibiae slightly bent in toward apex but not tuberculate-serrate, and *c.* 4 apical ventral setae each side.

Demetrida sibil n. sp.

Description. With characters of genus; form slender, with prominent eyes and spined elytra; head, prothorax, and *c.* basal ¼ of elytra dark greenish, the dark color extending farther back at sides of elytra than at middle, and suture sometimes red almost to base, rest of elytra red, femora and outer edges of tibiae greenish black, antennae brown, lower surface greenish black in anterior half, abdomen red; not pubescent, reticulate microsculpture faint even on elytra. *Head* 1.19 and 1.10 width prothorax; eyes moderately abruptly prominent, genae nearly as long as eyes, oblique; front flattened, irregularly slightly impressed and subpunctate at middle. *Prothorax* subquadrate; width/length 0.94 and 0.98; base/apex 1.38 and 1.28; base/head 0.81 and 0.82; sides weakly irregularly arcuate for much of length, rather abruptly sinuate before right or slightly acute sometimes slightly blunted posterior angles; margins narrow, each with seta-bearing puncture slightly before middle but none at base; disc strongly convex, with baso-lateral impressions weakly indicated, surface slightly punctate across base and in margins. *Elytra*: width elytra/prothorax 2.09 and 1.98; apices spined, outer angles acute or denticulate, sutural angles obtuse; striae

moderately impressed, finely punctulate; intervals slightly convex, very sparsely inconspicuously punctulate, 3rd 3-punctate (except intermediate puncture lacking on 1 side in 1 paratype). *Claws* with *c.* 6 teeth. *Secondary sexual characters*: ♂ tarsi as genus; ♂ middle tibiae bent-in at apex but not tuberculate-serrate; ♂ with apparently 4, ♀ *c.* 8 or 9 apical ventral setae each side. *Measurements*: length 9.4–10.8; width 3.0–3.4 mm.

Types. Holotype ♂ (Leiden Mus.) and 5 paratypes (2 in M.C.Z., Type No. 31,484) from Sibil, Star Rge., **West N. G.,** 1260 m, dates in May and June, 1959 (holotype, June 17) (Neth. New Guinea Exp.), taken at light; and additional paratypes as follows. **West N. G.**: 2, preceding locality ("Star Mts. Sibil Val."), 1245 m, Oct. 18–Nov. 8, 1961 (S. Quate, Bishop Mus.), at light. **N-E. N. G.**: 1, Feramin, 1200–1500 m, June 15–18, 1959 (W. W. Brandt, Bishop Mus.).

Measured specimens. The ♂ holotype and 1 ♀ paratype from Sibil.

Notes. The color (head and pronotum as well as elytral bases green) and long-spined elytra distinguish this from other species of the *diversa* complex.

Demetrida seticollis n. sp.

Description. With characters of genus; form as in Figure 109; brown, with head and prothorax and sometimes base of elytra slightly darker; appendages brown; not pubescent, reticulate microsculpture visible (but very light) only on elytra. *Head* 1.20 and 1.19 width prothorax; eyes very prominent, genae oblique and not sharply distinct from neck; front irregularly flattened or impressed and subpunctate at middle. *Prothorax* quadrate-trapezoidal; width/length 1.02 and 0.97; base/apex 1.45 and 1.29; base/head 0.86 and 0.90; sides weakly arcuate or *c.* straight in ¾ or more of length, strongly sinuate before prominent, *c.* right or acute (somewhat variable) basal angles; margins narrow, each with seta before middle and at base and additional usually smaller setae anteriorly; disc moderately convex, with irregular baso-lateral impressions, surface irregular or subpunctate across base and in margins. *Elytra* ample; width elytra/prothorax 2.20 and 2.22; apices long-spined, outer angles acute-denticulate, sutural angles obtuse; striae lightly impressed, finely punctulate; intervals slightly convex or *c.* flat, 3rd 3- or 4-punctate (variable, sometimes unsymmetric). *Claws* with 6–8 teeth. *Secondary sexual characters*: ♂ tarsi as genus; ♂ middle tibiae tuberculate-serrate (*c.* 4 widely sometimes irregularly spaced tubercles); ♂ with 2–4, ♀ *c.* 6 apical ventral setae each side. *Measurements*: length 8.7–10.5; width 2.9–3.4 mm (except 1 ♂ from Wissel Lakes, doubtfully identified, 11.3 × 3.7 mm).

Types. Holotype ♂ (Bishop Mus.) from Wissel Lakes, Enarotadi, **West N. G.,** 1900 m, Aug. 21, 1955 (Gressitt); 61 paratypes (some in M.C.Z., Type No. 31,485) from the Wissel Lakes area (Enarotadi, Moanemane, Itouda, Urapura, Okaitadi, "Paniai-Kamo div."), 1500–2050 m, dates in July, Aug., 1955, 1962 (Gressitt, Sedlacek); and 4 additional paratypes from the same area, Arabu Camp, 1800 m, Oct. 7, 8, 12, 17, 1939 (H. Boschma, Leiden Mus.).

Additional material. **West N. G.**: 1 very large ♂, data as holotype except 1500 m, Aug. 14, 1962 (Sedlacek); 2, Juliana Bivak, 1800 m, Aug. 30, Sept. 5, 1959 (Neth. N. G. Exp., Leiden Mus.); 1, Star Rge., Bivak 39A, 1500 m, July 2, 1959 (Neth. N. G. Exp., Leiden Mus.); 1, Swart Vy., W. ridge, 1800–2000 m, Nov. 19, 1958 (Gressitt). **N-E. N. G.**: 1, Gewak, Salawaket Rge., 1530 m, Sept. 6, 1956 (E. J. Ford, Jr., Bishop Mus.), in light trap. **Papua**: 1, Owen Stanley Rge., Goilala, Bome, 1950 m, Mar. 8–15, 1958 (W. W. Brandt, Bishop Mus.).

Measured specimens. The ♂ holotype and 1 ♀ paratype from Enarotadi.

Notes. The extra seta of the prothoracic margins anteriorly distinguish this species from all other nonpubescent *Demetrida* known to me. These setae are much

stronger and more erect than the fine extra marginal hairs of *D. seriata* and *nubicola*. When the setae are broken off, or perhaps lacking in aberrant individuals, the species is still recognizable by form especially of prothorax, color, and long elytral spines.

D. seticollis apparently ranges widely in New Guinea at considerable altitudes (not known below 1500 m) on the higher mountain ranges. The fact that it has not been found on the Morobe Plateau (Wau, etc.) is noteworthy.

Demetrida pallipes n. sp.

Description. With characters of genus; form slender, with moderately prominent eyes and strongly spined elytral apices; head and pronotum reddish piceous, elytra blackish with small discal area usually reddish, legs testaceous, antennae brown, lower surface dark with metepisterna paler; not pubescent, reticulate microsculpture absent or indistinct, surface not much punctulate. *Head* 1.14 and 1.16 width prothorax; eyes prominent, genae shorter, oblique. *Prothorax* subquadrate, long; width/length 1.03 and 0.96; base/apex 1.35 and 1.34; base/head 0.84 and 0.86; sides very weakly arcuate in *c.* anterior ¾, strongly sinuate before right or acute usually slightly blunted posterior angles; margins narrow, each with seta-bearing puncture before middle and at basal angle; disc with moderate baso-lateral impressions, scarcely punctate. *Elytra*: width elytra/prothorax 2.04 and 2.05; apices strongly spined, outer angles acute or denticulate, sutural angles obtuse; striae lightly impressed, finely irregularly punctulate; intervals almost flat, 3rd usually 2-punctate, sometimes 3-punctate on 1 side. *Claws* with *c.* 5 teeth. *Secondary sexual characters*: ♂ tarsi as genus; ♂ middle tibiae weakly tuberculate-serrate (*c.* 4 low tubercles); ♂ with 3, ♀ 5 or 6 apical ventral setae each side. *Measurements*: length 8.4–9.6; width 2.5–2.9 mm.

Types. Holotype ♂ (Bishop Mus.) and 19 paratypes (some in M.C.Z., Type No. 31,486) from Wau, Morobe Dist., **N-E. N. G.,** altitudes from 1100–1500 m, dates in Jan., Feb., Mar., Apr., Sept., Dec., 1961–1966 (holotype, 1450 m, Feb. 6, 1963) (Sedlacek, 1 paratype T. C. Maa); 1 paratype, Mt. Missim, 1600–2000 m, Sept. 21–24, 1964 (M. Sedlacek).

Measured specimens. The ♂ holotype and 1 ♀ paratype.

Notes. See *Key to Species* for place of *D. pallipes* among other New Guinean *Demetrida*.

Demetrida discoidalis n. sp.

Description. With characters of genus; form *c.* as in preceding species (*pallipes*); black, elytra with large elongate common red area centered behind middle, lower surface and appendages dark; not pubescent, reticulate microsculpture absent or indistinct on elytra, surface not much (sparsely inconspicuously) punctulate. *Head* 1.06 and 1.13 width prothorax; eyes prominent, genae shorter, oblique. *Prothorax* subquadrate, but anterior angles rounded to neck; width/length 1.04 and 1.00; base/apex 1.51 and 1.47; base/head 0.90 and 0.91; sides arcuate through much of length, sinuate before *c.* right slightly blunted posterior angles; margins narrow, each with seta-bearing puncture before middle and at base; disc with baso-lateral impressions weak, surface slightly irregular or subpunctate across base and in margins. *Elytra*: width elytra/prothorax 1.91 and 2.02; apices (variably) spined, outer angles sharply defined, varying from acute to slightly obtuse, sutural angles obtuse; striae lightly impressed, punctulate; intervals flat, 3rd 2-punctate. *Claws* with 6 or 7 teeth. *Secondary sexual characters*: ♂ tarsi as genus; ♂ middle tibiae tuberculate-serrate (*c.* 4 low rounded tubercles); ♂ with 2 or 3, ♀ 4 or 5 apical ventral setae each side. *Measurements*: length 9.0–11.5; width 3.0–3.7 mm.

Types. Holotype ♂ (Bishop Mus.) from Sibil Vy., Star Rge., **West N. G.,** 1245 m,

Oct. 18–Nov. 8, 1961 (S. & L. Quate), in Malaise trap; and paratypes as follows. **West N. G.**: 1, Sibil, Star Rge., 1260 m, June 1959; 2, Bivak 36, Star Rge., 1220 m, July 28, 1959; 1, Bivak 39A, Star Rge., 1550 m, July 5, 1959 (these 4 paratypes all Neth. N. G. Exp., Leiden Mus.). **N-E. N. G.**: 1, Eliptamin Vy., 1665–2530 m, June 19, 1959 (W. W. Brandt, Bishop Mus.); 1, Feramin, 1200–1500 m, June 15–18, 1959 (W. W. Brandt, Bishop Mus.). (Some paratypes in M.C.Z., Type No. 31,487.)

Measured specimens. The ♂ holotype and ♀ paratype from Bivak 39A.

Notes. This may be a geographic representative of the preceding species (*pallipes*) from which it differs only slightly in form but more in color, with larger red area on elytra and dark rather than pale legs. It resembles *dorsalis* in color but differs in form (much narrower than *dorsalis*), presence of posterior-lateral prothoracic setae, and in other ways: in fact, these 2 species are not closely related.

Demetrida sedlacekorum n. sp.

Description. With characters of genus; form slender, *c.* as in preceding species (*pallipes*, *discoidalis*) but elytra short-spined; black with bluish tone especially on elytra, appendages dark; not pubescent; reticulate microsculpture absent or indistinct, but upper surface in part with very fine, sparse, inconspicuous punctulation. *Head* 1.14 and 1.08 width prothorax; eyes prominent, genae shorter, oblique. *Prothorax* subquadrate, long, with rather broad base; width/length 0.98 and 0.99; base/apex 1.41 and 1.43; base/head 0.86 and 0.87; sides weakly arcuate in *c.* ¾ of length, sinuate before *c.* right but variable, blunted posterior angles; margins rather narrow, each with seta-bearing puncture before middle and at basal angle; disc with baso-lateral impressions deep but small, subpunctate. *Elytra*: width elytra/prothorax 2.03 and 1.93; apices short-spined, outer angles sharply defined, usually acute, sutural angles obtuse; striae lightly impressed, punctulate; intervals flat or slightly convex, third usually 2-, sometimes 3-punctate. *Claws* with 6 or 7 teeth. *Secondary sexual characters*: ♂ tarsi as genus; ♂ middle tibiae weakly tuberculate-serrate (margin wavy); ♂ with 2 or 3, ♀ 4 or 5 apical ventral setae each side. *Measurements*: length 8.5–9.8; width 2.6–3.1 mm.

Types. Holotype ♂ (Bishop Mus.) and 28 paratypes (some in M.C.Z., Type No. 31,488) all from Wau, Morobe Dist., **N-E. N. G.**, altitudes from 1180 to 1500 m, dates in Jan., Feb., Mar., Apr., June, Sept., Nov., 1961–1964 (holotype, 1220–1250 m, Jan. 23, 1963) (Sedlaceks).

Additional material. **N-E. N. G.**: 2, Jim(m)i R., E. Highlands, July–Sept., 1961 (W. W. Brandt, C.S.I.R.O.). **Papua**: 1, Owen Stanley Rge., Goilala, Tororo, 1560 m, Feb. 21–24, 1958 (W. W. Brandt, Bishop Mus.).

Measured specimens. The ♂ holotype and 1 ♀ paratype.

Notes. See final couplets of *Key to Species* for place of *sedlacekorum* among other New Guinean *Demetrida*.

Demetrida brandti n. sp.

Description. See Plate 3, figure XII; with characters of genus; form *c.* of *pallipes* and *discoidalis*, slender, with long-spined elytra; color entirely blue-black, with dark appendages; not pubescent, microsculpture virtually absent even on elytra, surface not much (very finely, sparsely, inconspicuously) punctulate. *Head* 1.09 and 1.07 width prothorax; eyes prominent, genae shorter, oblique. *Prothorax* quadrate, long; width/length 0.98 and 1.03; base/apex 1.44 and 1.43; base/head 0.87 and 0.88; sides weakly arcuate in *c.* anterior ¾, broadly sinuate before *c.* right or slightly acute posterior angles; margins rather narrow each with seta near or before middle and at base; baso-lateral impressions moderate, subpunctate. *Elytra*: width elytra/prothorax 1.98 and 1.94; apices with moderately long spines, outer angles well defined, ± right, sutural angles blunted; striae slightly

impressed, faintly punctulate; intervals slightly convex, 3rd 2-punctate. *Claws* with *c.* 6 teeth. *Secondary sexual characters*: ♂ tarsi as genus; ♂ middle tibiae tuberculate-serrate (*c.* 4 tubercles); ♂ with 3, ♀ 4 or 5 apical ventral setae each side. *Measurements*: length 8.8–10.2; width 2.8–3.3 mm.

Types. Holotype ♂ (Bishop Mus.) and 2 paratypes from Finisterre Rge., Saidor, Kiambavi Village, **N-E. N. G.,** 1400 m, July 22–29 (holotype), Aug. 1–28 (paratypes); 1 paratype, Saidor, Funyende, 1200 m, Sept. 24; 2 paratypes, Saidor, Matoko, Aug. 29–Sept. 5, Sept. 6–24 (all collected 1958 by W. W. Brandt for Bishop Mus.; some paratypes now in M.C.Z., Type No. 31,489).

Additional material. **N-E. N. G.**: 2, Swart Vy., Karubaka, 1500 m, Sept. 20, 1958 (Gressitt); 1, Gewak, Salawaket Rge., 1530 m, Sept. 6, 1956 (E. J. Ford, Jr., Bishop Mus.), in light trap. **West N. G.**: 2, Wamena, 1700 m, Feb. 10–25, 1960 (T. C. Maa, Bishop Mus.). **Papua**: 1, Purosa Camp, Okapa area, 1950 m, Sept. 23, 1959 (L. J. Brass, Sixth Archbold Exp., A.M.N.H.).

Measured specimens. The ♂ holotype and 1 ♀ paratype from Kiambavi.

Notes. This will probably prove to be a geographic subspecies of *sedlacekorum* distinguished mainly by longer elytral spines.

Genus *PHLOEOCARABUS* Macleay

Macleay 1871, Trans. Ent. Soc. New South Wales 2, p. 85.
Sloane 1898, Proc. Linnean Soc. New South Wales 23, p. 499.
Csiki 1932, Coleop. Cat., Carabidae, Harpalinae 7, p. 1488 (see for additional references, synonymy, and list of species).

Diagnosis. See *Key to Genera of Lebiini of New Guinea* and Figure 110.

Description (characters common to the 2 New Guinean species). Form *c.* as in Figure 110; color diverse; not pubescent. *Head*: eyes large, prominent; 2 setae over each eye; antennae pubescent from middle of 4th segments; front with long, slightly curved costa on each side passing inside position of anterior seta; clypeus transverse, 1-setose each side; labrum wide, arcuate-truncate, 6-setose; mentum with long, entire tooth; ligula subtruncate with 2 principal setae, paraglossae attached to ligula, narrowed and rounded to apex of ligula; palpi rather short, apical segments of labial palpi widened, *c.* triangular. *Prothorax* transverse, arcuately narrowed anteriorly, slightly lobed at base; margins rather wide, flat, scarcely reflexed, each with usual 2 setae; disc with impressed middle line and weak transverse impressions; base with fine marginal line entire or nearly so, apex not margined at middle. *Elytra* with rounded, slightly narrowed humeri; apices obliquely sinuate-truncate, with outer angles broadly and inner angles narrowly rounded; striae entire, moderately impressed, not punctate; intervals not specially elevated at base, 3rd 2-punctate with punctures before middle on outer edge and behind apical ¼ near inner edge. *Inner wings* full. *Legs* moderate; 4th segments middle and hind tarsi emarginate; 5th segments with accessory setae; claws each with *c.* 4 rather long teeth. *Secondary sexual characters*: ♂ front tarsi scarcely dilated, 2-seriately squamulose; ♂ middle tarsi also squamulose; ♂ middle tibiae not excised; ♂ with 1 principal (sometimes a 2nd smaller), ♀ 2 setae each side last ventral segment.

Type species. P. mastersi Macleay, of Australia.

Generic distribution. **Australia**, with 1 Australian species extending to **New Guinea** and **New Britain**, and an additional species endemic in New Guinea.

Notes. The 2 species here assigned to *Phloeocarabus* are very different superficially but share the technical characters of the genus.

Key to Species of *Phloeocarabus* of New Guinea

1. Color black or piceous, elytra with testaceous marks (p. 184) ... *nigricollis*
– Strikingly bicolored, head and prothorax red, elytra blue (p. 184) ... *cuplenes*

Phloeocarabus nigricollis (Macleay)

Macleay 1864, Trans. Ent. Soc. New South Wales 1, p. 111 (*Trigonothops*).
See also references under genus.
basalis Sloane 1907, Deutsche Ent. Zeitschrift for 1907, p. 182 (new synonymy).

Description. None required here; length *c.* 6–8 mm.

Types. Of *nigricollis*, from Port Denison (Bowen), Queensland, **Australia**, presumably in Macleay Mus., Sydney; of *basalis*, from the Gazelle Pen., **New Britain**, should be in Deutsche Ent. Institut, Berlin-Dahlem (none seen).

Occurrence in New Guinea. Thirty-four specimens, from localities covering almost the whole length of **New Guinea**, most at low altitudes but records up to 1300 (at Wau), 1400, and 1500 m.

Notes. Sloane distinguished *basalis* from *nigricollis* by a slight color difference, which does not hold in the series before me: 5 specimens from New Britain include both individuals with base of elytra entirely dark (*basalis*) and individuals with the pale marks reaching the elytral base (*nigricollis*). The series from New Guinea is even more variable, with elytra ranging from almost wholly reddish testaceous to almost wholly piceous with subbasal pale marks scarcely indicated. The pronotum also varies, from reddish piceous with pale margins to reddish testaceous, and the variation is partly independent of the variation of elytral pattern. All these color forms seem to me to be one species. The variation of pattern may prove to be partly geographic, but the material before me is not sufficient to establish this.

Phloeocarabus euplenes n. sp.

Description. With characters of genus; form as in Figure 110; strikingly bicolored, head and prothorax red, elytra blue, lower surface and appendages reddish testaceous; moderately shining, reticulate microsculpture absent or faint on front and on disc of pronotum, distinct and slightly transverse on elytra. *Head*: 0.76 and 0.76 width prothorax; front scarcely impressed, faintly sparsely punctulate. *Prothorax*: width/length 1.58 and 1.62; base/apex 1.67 and 1.62; margins broadly flattened, not much reflexed; disc sparsely irregularly punctulate and faintly transversely strigulose. *Elytra*: width elytra/prothorax 1.42 and 1.47; striae well impressed, faintly punctulate; intervals slightly convex, each with an irregular row of punctules along middle. *Secondary sexual characters*: ♂ as for genus; ♀ unknown. *Measurements*: length 5.0–5.2; width 2.1–2.2 mm.

Types. Holotype ♂ (Bishop Mus.) from Torricelli Mts., Wantipi Village, **N-E. N. G.**, Nov. 30–Dec. 8, 1958 (W. W. Brandt); and 1 ♂ paratype (M.C.Z., Type No. 31,490) from Kiunga, Fly R., **Papua**, July 11–14, 1957 (W. W. Brandt).

Notes. This new *Phloeocarabus* is strikingly different in color from any other member of the genus known to me. In form and color it resembles and may mimic New Guinean species of the agonine genus *Euplenes*.

Genus *TRIGONOTHOPS* Macleay

Macleay 1864, Trans. Ent. Soc. New South Wales 1, p. 110.
Csiki 1932, Coleop. Cat., Carabidae, Harpalinae 7, p. 1488 (see for additional references and list of species).

Diagnosis. See *Key to Genera of Lebiini of New Guinea* and *Notes* under the following species.

Description. None required here.

Type species. Calleida pacifica Erichson of Australia (original designation).

Generic distribution. Heretofore known only from **Australia** including **Tasmania** and other close-lying islands; range now extended to **New Guinea**.

Notes. The Australian members of this genus live on tree trunks, I think.

Trigonothops lateralis n. sp.

Description. Form as in Figure 111; entirely (slightly reddish) yellow except for a wide brownish black stripe along the

outer side of each elytron (not including the reflexed margin) from humerus nearly to apex; not pubescent; moderately shining, with lightly impressed reticulate microsculpture isodiametric on front, slightly transverse on disc of pronotum and elytra. *Head* 0.86 width prothorax; 2 setae over each eye; front slightly impressed at middle, longitudinally impressed each side anteriorly; clypeus broadly rounded anteriorly (a small notch at middle may be abnormal), 1-setose each side; labrum transverse, irregularly broadly rounded in front, 6-setose; mentum with triangular tooth; ligula thickened, blunt, probably originally setose but setae broken short; paraglossae *c.* long as or slightly shorter than ligula, attached except at extreme apex, apparently without setae; maxillary palpi not or not much thickened, labial palpi with apical segments wider, not quite ½ wide as long, narrowly obliquely truncate. *Prothorax* subcordate but with broad base; width/length 1.44; base/apex 1.54; base broadly briefly lobed, margined; apex broadly emarginate, not distinctly margined at middle; side margins broad and reflexed especially toward base, each with 2 seta-bearing punctures, at basal angle and *c.* ⅓ from apex; disc with middle line deep, transverse impressions less well defined, baso-lateral foveae deep but not sharply limited; surface of disc with faint weak transverse strigulation, almost impunctate. *Elytra*: width elytra/prothorax 1.94; humeri slightly narrowed and rounded but not obliterated; reflexed lateral margins moderate; apices slightly obliquely truncate and very slightly sinuate, with outer angles broadly and sutural angles narrowly rounded; striae entire, moderately impressed, faintly irregular but not distinctly punctulate; intervals slightly convex, not distinctly punctate except 3rd with 2 small dorsal punctures, on inner edge just before middle and behind apical ¼ (subbasal puncture, if present, minute and not surely detectable). *Inner wings* full. *Legs*: hind tarsi missing; middle tarsi with 4th segments very deeply emarginate, with lobes much longer than ½ length of segment; claws (of front tarsi) each with 4 long teeth and apparently an additional very short tooth toward base; 5th segments (of front tarsi) with accessory setae. *Secondary sexual characters*: ♂ unknown; ♀ with last ventral segment subtruncate, slightly subsinuate at middle, with 2 setae near apex each side. *Measurements*: length 6.7; width 2.9 mm.

Type. Holotype ♀ (Leiden Mus.) from Wissel Lakes, central **West N. G.,** Arabu Camp, 1800 m, Oct. 12, 1939 (H. Boschma); the type is unique.

Notes. Even without the ♂ I am reasonably sure that this insect is a *Trigonothops.* It agrees with *T. pacificus* Erichson in form and in significant characters including the mouthparts (see preceding *Description*) and position of the dorsal elytral punctures. Moreover, the elytral color pattern is derivable from that of *Trigonothops pacificus*: lateral stripes like those of *lateralis* would be left if the inner portion of the dark elytral pattern of *pacificus* were erased.

This individual had lost most of its legs before I received it. Only the left front leg is still complete, and the left middle leg is complete except for the 5th segment. But these are enough to show essential characters, and the specimen is in good condition otherwise.

Genus *NOTOTARUS* Chaudoir

Chaudoir 1875, Bull. Soc. Nat. Moscow 49, Part 2, p. 19.
Sloane 1898, Proc. Linnean Soc. New South Wales 23, p. 494.

Diagnosis. As *Anomotarus* (following genus) but side pieces of metasternum short, scarcely longer than wide; and (in the New Guinean species) genae short-setulose; antennae with segments 2 and 3 more or less pubescent; tarsi pubescent (sparsely short-pilose) above; ♂ middle tibiae not modified.

Description. See *Notes* (below) and detailed *Description* of following species.

Type species. Nototarus australis Chaudoir, of Western Australia.

Generic distribution. Previously known only from **Australia**; range now extended to **New Guinea**.

Notes. Chaudoir described *Nototarus* as without a mentum tooth, and the tooth is certainly difficult to see in some Australian species, but it may be depigmented rather than absent. The characters and generic classification of this group of Carabidae need further study, which will have to be based on the Australian rather than New Guinean forms. Some Australian species assigned to *Nototarus* by Sloane do have the mentum toothed, and the single New Guinean species (below) is evidently closely related to some of them.

Nototarus papua n. sp.

Description. Form as in Figure 112; brownish black, humeri broadly paler brown, appendages brownish testaceous; reticulate microsculpture lightly impressed, *c.* isodiametric on front, slightly transverse on pronotum, more irregular on elytra, and surface irregularly rather sparsely punctulate. *Head* 0.81 and 0.80 width prothorax; eyes moderately prominent, genae rounded-oblique, short-setulose; 2 setae over each eye; front longitudinally rugulose each side; clypeus slightly emarginate-truncate, 1-setose each side; labrum wide, slightly emarginate-truncate, 6-setose; mandibles rather short, curved; antennae moderate, pubescent from middle of 3rd segments; mentum with long, narrowly rounded tooth; ligula 2-setose, paraglossae attached, equal in length, wide, not setose; maxillary palpi slender, labial palpi with apical segments wide. *Prothorax* cordate, short-lobed at base; width/length 1.31 and 1.30; base apex 0.88 and 0.92; margins narrow, each with seta at basal angle and *c.* ¼ from apex; basal and apical marginal lines interrupted at middle; disc with middle line coarse, almost entire, transverse impressions almost obsolete. *Elytra* short, narrowed toward base, connate; width elytra/prothorax 1.49 and 1.51; striae entire, impressed, faintly punctulate; intervals convex especially toward base, 3rd 2-punctate, the punctures near middle of length and *c.* ¼ from apex. *Inner wings* vestigial. *Lower surface* not obviously pubescent (in part with very short inconspicuous sparse pubescence). *Legs* moderate; tarsi short-pilose above; 4th segments middle and hind tarsi slightly emarginate; 5th segments with long accessory setae; claws each with 3 or 4 teeth. *Secondary sexual characters*: labial palpi with apical segments wider in ♂ (truncate apex wider than length of inner edge), narrower in ♀ (truncate apex narrower than inner edge); ♂ front tarsi slightly (scarcely) dilated, 3 segments 2-seriately squamulose; ♂ middle tarsi not squamulose; ♂ middle tibiae not modified; ♂ with 1, ♀ 2 seta-bearing punctures each side last ventral segment. *Measurements*: length 4.6–5.3; width 1.9–2.3 mm.

Types. Holotype ♂ (M.C.Z., Type No. 31,491) and 20 paratypes all from Dobodura, **Papua**, Mar.–July 1944 (Darlington).

Measured specimens. The ♂ holotype and 1 ♀ paratype.

Notes. This is the only *Nototarus* thus far found in New Guinea. It may be related to *N. morosus* Sloane of Port Darwin, Australia, but has the prothorax evidently more narrowed posteriorly, with sinuate sides. Other, apparently related, undescribed species occur in North Queensland.

This species is one of the very few strictly flightless Carabidae found at low altitudes in New Guinea. Most or all of my specimens were, I think, taken in flood debris from the floor of rain forest. The rain-forest-floor habitat and the insect's flightlessness perhaps explain why other collectors have not found it.

Genus *ANOMOTARUS* Chaudoir

Chaudoir 1875, Bull. Soc. Nat. Moscow 49, Part 2, p. 48.

Sloane 1898, Proc. Linnean Soc. New South Wales 23, p. 494.
Csiki 1932, Coleop. Cat., Carabidae, Harpalinae 7, p. 1493 (see for additional references, synonymy, and list of species).
Jedlicka 1963, Ent. Abhandlungen 28, pp. 300, 450.

Diagnosis. See *Key to Genera of Lebiini of New Guinea.*

Description (based on New Guinean species only). Form as in Figures 113–117; small, slender, depressed; elytra usually (not always) with characteristic pale marks; not pubescent. *Head*: eyes moderately prominent, genae rounded, more or less prominent (usually less so than eyes); 2 setae over each eye; antennae moderate, pubescent from 4th segment (3rd segment with only usual apical setae); clypeus transverse with rounded angles, 1-setose each side; labrum transverse, broadly emarginate, 6-setose; mandibles short, strongly curved; mentum with long tooth; ligula rather broad, 2-setose, paraglossae attached and *c.* equal in length, wide, not setose; maxillary palpi moderate, not widened; labial palpi with apical segments widened. *Prothorax* cordate, with base briefly lobed; side margins moderate or narrow, with setae at basal angle and *c.* ¼ or ⅓ from apex; disc with impressed middle line and less distinct transverse impressions. *Elytra* with apices simple; striae entire, not distinctly punctate; 3rd intervals 2-punctate, with punctures near or before middle and *c.* ¼ from apex; 8th intervals usually finely carinate on inner edge near base (carinae sometimes so fine as to be scarcely detectable). *Inner wings* full. *Lower surface* not extensively pubescent; side pieces of metasternum long. *Legs* slender; tarsi not pubescent above; 4th segments middle and hind tarsi slightly emarginate; 5th segment with long accessory setae; claws with *c.* 4 or 5 teeth. *Secondary sexual characters*: ♂ front tarsi slightly (scarcely) dilated, 3 segments 2-seriately squamulose; last segment ♂ labial palpus wider (truncate outer edge almost as long as inner side), of ♀ less wide; ♂ middle tarsi without squamae; ♂ middle tibiae with inner edge tuberculate-serrate (cf. *Demetrida*), with *c.* 3 or 4 low tubercles in row toward apex (in all New Guinean species of which the ♂ is known); ♂ with 1, ♀ 2 setae each side last ventral segment.

Type species. Anomotarus olivaceus Chaudoir, from Melbourne, Australia.

Generic distribution. Southern **Asia** (**Ceylon**, **India**, **Japan**, etc.) to **Australia** and **Tasmania**, and **New Caledonia**.

Notes. Although I recognize 8 (closely interallied) species of *Anomotarus* in **New Guinea**, material is scanty and almost nothing is known of their habits. I think most of them probably live among dead leaves on the ground in rain forest. A few specimens have been taken at light.

KEY TO SPECIES OF *ANOMOTARUS* OF NEW GUINEA

1. Each elytron *either* with *longitudinal* post-humeral stripe (outside 4th stria) and subapical-sutural spot pale, *or* with only the subapical spot, *or* unmarked 2
– Each elytron with a more or less incomplete *oblique or transverse* (not longitudinal) spot or band before middle and usually (not always) a subapical-sutural spot pale 5
2. Very slender (prothoracic width/length 1.15); subsericeous black, unmarked (p. 188) ..... *gressitti*
– Less slender (prothoracic width/length *c.* 1.20 or more); elytra with at least subapical-sutural pale spot(s) 3
3. Elytra with distinct post-humeral stripes (as well as subapical-sutural spot(s)) pale; prothorax less narrowed basally (base/apex *c.* 1.10 or more) (p. 188) ..... (*stigmula*)
– Post-humeral stripes indistinct or absent (subapical-sutural spot(s) distinct); prothorax more narrowed basally (base/apex 1.05 or less) 4
4. Brown, with subapical-sutural spots small and separated; prothorax narrowed (width/length 1.22 and 1.23); elytra more narrowed toward base (p. 188) ..... *wallacei*
– Black, with subapical-sutural spots united in conspicuous square plagia; prothorax wider (width/length 1.35); elytra less narrowed toward base (Fig. 115) (p. 189) ..... *plagifer*
5. Each elytron with transverse-oval pale spot before middle but without subapical spot (Fig. 114) (p. 189) ..... *ocellatus*

– Elytra with anterior and posterior pale spots 6

6. Elytra with an almost strictly transverse, regular, *c.* entire pale fascia before middle (as well as an incomplete subapical fascia); elytral margins bicolored; femora bicolored; surface in part sericeous; length 5.5–6.0 mm (p. 189) ..... *transversus*

– Anterior elytral marks more oblique and/or more irregular and/or more interrupted; elytral margin usually entirely translucent-testaceous; femora not bicolored; surface not or not so strongly sericeous, more shining; size usually smaller 7

7. Anterior elytral marks usually more oblique; femora pale (Moluccas and western and central New Guinea) (p. 190) ..... *ornatus*

– Anterior elytral marks more nearly transverse; femora darker (central and eastern New Guinea) 8

8. Prothorax wider (width/length 1.38 and 1.41); markings wide (p. 190) ..... *fuscipes*

– Prothorax narrower (width/length 1.27); markings narrower (Fig. 117) (see also *Description*) (p. 191) ..... *wau*

Anomotarus gressitti n. sp.

Description. With characters of genus; form as in Figure 113; slender; black, not marked, but margins of prothorax and especially of elytra more or less pale translucent; surface dull, closely punctulate and microreticulate, elytra subalutaceous; legs testaceous, antennae and mouthparts brownish testaceous. *Head* 0.80 width prothorax. *Prothorax*: width/length 1.15; base/apex 1.00. *Elytra*: width elytra/prothorax 1.73; striae lightly impressed, faintly punctulate; intervals *c.* flat, 6th, 7th, and 8th with inner edges finely carinate for increasing distances from base. *Measurements*: length *c.* 5.0; width 1.9 mm.

Type. Holotype ♀ (Bishop Mus.), from Maprik, **N-E. N. G.,** 160 m, Oct. 14, 1957 (Gressitt); the type is unique.

Notes. The slender form and dull black color, without markings, should make this species easy to recognize.

(*Anomotarus stigmula* (Chaudoir))

Chaudoir 1852, Bull. Soc. Nat. Moscow 25, Part 1, p. 57 (*Cymindis*).

Andrewes 1930, Cat. Indian Insects 18, Carabidae, p. 28.

Csiki 1932, Coleop. Cat., Carabidae, Harpalinae 7, p. 1493 (see for synonymy and additional references).

Louwerens 1953, Verhandlungen Naturforschenden Gesellschaft Basel 64, p. 316.

Jedlicka 1963, Ent. Abhandlungen 28, p. 451.

Description. With characters of genus; form, including elytra, elongate; brown, elytra each with longitudinal humeral mark (outside 4th stria) and variable apical mark pale; appendages including femora testaceous; rather shining, but surface finely microreticulate and sparsely inconspicuously punctulate. *Head* 0.84 and 0.86 width prothorax. *Prothorax*: width/length 1.24 and 1.29; base/apex 1.14 and 1.11; margins moderate, with basal angles well defined, *c.* right or obtuse (not acute). *Elytra* long; width elytra/prothorax 1.65 and 1.69; striae moderately impressed, not distinctly punctulate. *Measurements*: length *c.* 4.7–5.3; width *c.* 1.9–2.1 mm.

Type. From Simla(h), northern **India**; now in Oberthür Coll., Paris Mus. (not seen).

Occurrence in New Guinea. Doubtful; see following *Notes.*

Measured specimens. A ♂ from Coimbatore, South India, and ♀ from Lawa, Malita, Davao Prov., Mindanao, Philippine Islands (both specimens M.C.Z.).

Notes. This species is now recorded over a very wide area, from **SE. Asia** including **Ceylon** and **Japan** to **Timor** and **New Caledonia**, but apparently not Australia. New Guinea is included in the species' range by Andrewes and Csiki, but I have found no detailed record of its occurrence there. I suspect its supposed occurrence is erroneous, based on the old specimens in the British Museum described below as *wallacei.* I have not seen true *stigmula* from New Guinea.

Anomotarus wallacei n. sp.

Description. With characters of genus; form shorter than usual in genus; brownish piceous, elytra each with faint paler area behind humerus (corresponding to post-

humeral spot of *stigmula*), a small testaceous spot on intervals 2 and 3 just before apex, and lateral margin narrowly brownish testaceous; appendages brownish testaceous; surface (in part) moderately shining, with reticulate microsculpture lightly impressed and punctulation rather sparse. *Head* 0.84 and 0.89 width prothorax. *Prothorax*: width/length 1.23 and 1.22; base/apex 1.00 and 1.05. *Elytra* shorter and more narrowed basally than usual in genus; width elytra/prothorax 1.69 and 1.74; striae moderately impressed, not distinctly punctulate. *Inner wings* apparently fully developed in spite of narrowing of humeri. *Measurements*: length 4.3–4.9; width 1.8–2.0 mm.

Types. Holotype ♀ (British Mus.) and 1 ♀ paratype (M.C.Z., Type No. 31,492) both from Dory, **West N. G.** (presumably collected by Wallace); ♂ unknown.

Notes. This species is very close to *stigmula* (above) but has elytra shorter, more narrowed at base, and with markings reduced, and the prothorax coaptively narrowed at base, as the ratio base/apex shows. It may prove to be a geographic subspecies of *stigmula*. It may prove not to be from New Guinea (because the "Dory" locality is always dubious), but it seems not to be known anywhere else.

Anomotarus plagifer n. sp.

Description. With characters of genus; form as in Figure 115; brownish black, elytra with conspicuous, common, square spot just before apex pale and lateral margins slightly pale translucent; appendages testaceous; surface rather shining but lightly microreticulate and faintly sparsely punctulate. *Head* 0.88 width prothorax. *Prothorax* strongly cordate (more so than in *stigmula*); width/length 1.35; base/apex 1.02; posterior angles abruptly right-acute. *Elytra* of moderate length, slightly narrowed toward base (less than in *wallacei*); width elytra/prothorax 1.57; striae well impressed, not distinctly punctulate. *Measurements*: length *c.* 4.9; width *c.* 2.0 mm.

Type. Holotype ♂ (Bishop Mus.) from Port Moresby, **Papua**, May 20, 1956 (Gressitt), taken in light trap; the type is unique.

Notes. As compared with *stigmula*, *plagifer* is slightly broader, with more cordate prothorax, and is darker in color, without basal but with more conspicuous subapical elytral marks.

Anomotarus ocellatus n. sp.

Description. With characters of genus; form as in Figure 114; black (bluish black in some lights), each elytron with transverse-oval pale spot before middle between striae 1 and 7; appendages brownish testaceous, femora darker brown; shining, reticulate microsculpture light (faint on part of pronotal disc) and punctulation very fine, faint, sparse. *Head* 0.85 width prothorax. *Prothorax* cordate; width/length 1.31; base/apex 0.96; side margins narrower than usual. *Elytra*: width elytra/prothorax 1.59; striae moderately impressed. *Measurements*: length 4.4; width 1.8 mm.

Type. Holotype ♀ (Louwerens Coll., eventually to Leiden Mus.) from Sorong "Kpg. Roefci," **West N. G.,** July 8–Aug. 14, 1948 (M. A. Lieftinck); the type is unique.

Notes. The small size, relatively shining surface, and unique markings distinguish this species.

Anomotarus transversus n. sp.

Description. With characters of genus; form as in Figure 116; large, with wide-cordate prothorax; dull aeneous black, elytra more alutaceous, with *c.* entire cross-band before middle and incomplete transverse mark before apex pale; elytral margins bicolored, pale at transverse fascia, dusky elsewhere; femora bicolored, dark with pale apices; appendages otherwise brownish testaceous, antennae slightly darker distally; surface closely microreticulate, sparsely punctulate. *Head* 0.72 and 0.76 width prothorax. *Prothorax*: width/length 1.46 and 1.43; base/apex 1.08 and 1.03; posterior angles abruptly acute. *Elytra*:

width elytra/prothorax 1.46 and 1.44; striae fine, lightly impressed, not punctulate; intervals almost flat. *Measurements*: length *c.* 5.5–6.0; width 2.1–2.3 mm.

Types. Holotype ♂ (M.C.Z., Type No. 31,493) and 1 ♀ paratype both from Dobodura, **Papua**, Mar.–July 1944 (Darlington); 3 paratypes, Popondetta, **Papua**, 60 m, Aug. 30–31, Sept. 1–4, 1963 (Sedlacek), light trap.

Notes. The large size, dull partly alutaceous surface, and color pattern, especially the evenly transverse anterior elytral fascia, characterize this species.

Anomotarus ornatus Louwerens

Louwerens 1956, Treubia 23, p. 237.

Description. With characters of genus; form *c.* as of following species (*fuscipes*); piceous black, elytra each with broad pale mark before middle, this mark being irregularly transverse-oblique with outer-anterior corner extended toward and sometimes reaching humerus, and elytra also with subapical-sutural spot pale and lateral margins entirely pale; legs entirely testaceous; antennae brownish testaceous; surface shining, reticulate microsculpture light on head, faint on disc of pronotum, more distinct on elytra. *Head* 0.86, 0.85, and 0.83 width prothorax. *Prothorax* cordate; width/length 1.43, 1.36, and 1.33; base/apex 1.08, 1.07, and 1.08; posterior angles abruptly right or acute. *Elytra*: width elytra/prothorax 1.72, 1.77, and 1.77; striae moderately impressed, not punctulate. *Measurements*: length 5.1–5.8; width 2.2–2.4 mm.

Types. From **Obi Is.** (Laiwui, 0–200 m, Sept.–Oct. 1953, A. M. R. Wegner); holotype in Leiden Mus. (not seen).

Occurrence in New Guinea. **West N. G.**: 8, Cyclops Mts., Sabron, Camp 2, 2000 ft. (610 m), July 1936 (Cheesman); 4, vic. Hollandia (various collectors); 1, Kebar Vy. W. of Manokwari, 550 m, Jan. 4–31, 1962 (S. & L. Quate, Bishop Mus.), in light trap; 1, Sansapor, Aug. 1944 (Darlington).

Measured specimens. A pair (♂ ♀) from Cyclops Mts. and a ♀ paratype from Obi Is.; figures given in this order.

Notes. See under the following species (*fuscipes*).

Anomotarus fuscipes n. sp.

Description. With characters of genus; form average; black (slightly brownish or aeneous), elytra each with slightly oblique transverse fascia just before middle and subapical-sutural spot pale and lateral margins entirely pale brownish translucent; femora brown (not distinctly bicolored), tibiae and tarsi paler; antennae brown; upper surface rather shining, reticulate microsculpture light especially on disc of pronotum. *Head* 0.76 and 0.77 width prothorax. *Prothorax* cordate; width/length 1.38 and 1.41; base/apex 1.17 and 1.09; basal angles abruptly right or acute. *Elytra*: width elytra/prothorax 1.66 and 1.59; striae moderately impressed, not punctulate. *Measurements*: length 4.1–5.5; width 1.9–2.3 mm.

Types. Holotype ♂ (M.C.Z., Type No. 31,494) from Dobodura, **Papua**, Mar.–July 1944 (Darlington); and paratypes as follows. **Papua**: 1, Karema, Brown R., Mar. 8–11, 1955 (E. O. Wilson, M.C.Z.), taken in lowland rain forest; 2, Mt. Riu, Sudest Is., 250–350 m, "No. 10," Sept. 3, 5, 1956 (L. J. Brass, A.M.N.H.); 1, Abaleti, Rossel Is., 0–50 m, "No. 12," Oct. 9, 1956 (Brass, A.M.N.H.). **N-E. N. G.**: 1, vic. Nadzab, July 1944 (Darlington); 1, same locality, May 20–22, 1955 (E. O. Wilson, M.C.Z.), in dry evergreen forest; 1, Erima, Astrolabe Bay, 1896 (Biró); 1, Stephansort, Astrolabe Bay, 1898 (Biró). **West N. G.**: 4, Hollandia, Nov. 21, 1944; May 1945; May 4, 1947 (Hoogstraal, M.C.Z.); 1, same locality, May 1945 (Malkin, U.S.N.M.).

Measured specimens. The ♂ holotype and 1 ♀ paratype from Hollandia.

Notes. This species is very close to the preceding (*ornatus*), but is distinguished by brown rather than testaceous femora and by more transverse anterior elytral

fascia which approaches the humeri less closely, although this mark varies somewhat in both species. *A. fuscipes* occupies approximately the eastern half of New Guinea, *ornatus* the western half and the Moluccas, but their ranges are not strictly allopatric, since both occur in the vicinity of Hollandia.

Anomotarus wau n. sp.

Description. With characters of genus; form as in Figure 117; black, elytra each with oblique fascia before middle and with common subapical-sutural spot testaceous and margins brownish translucent; appendages brownish testaceous with femora darker; shining, reticulate microsculpture and fine sparse punctulation present but light especially on pronotum. *Head* 0.84 width prothorax. *Prothorax* narrow-cordate, with relatively narrow margins; width/length 1.27; base/apex 1.05; sides more oblique posteriorly (less broadly rounded) than in *fuscipes*, with posterior angles abruptly *c.* right. *Elytra*: width elytra/prothorax 1.67; striae well impressed, not punctulate. *Measurements*: length 5.1; width 2.0 mm.

Type. Holotype ♀ (Bishop Mus.) from Wau, Morobe Dist., **N-E. N. G.,** 1200 m, July 5, 1961 (Sedlaceks), taken in light trap; the type is unique.

Notes. Although this may be only a form of the preceding species (*fuscipes*), it has a relatively narrow prothorax and reduced elytral fasciae and will probably prove to be worth distinguishing. More material from more localities is needed to show whether it is a species or a geographic subspecies.

Tribe PENTAGONICINI

Pentagonicidae Auct. including Jeannel 1949, Coléop. Carabiques de la Région Malgache, Part 3, p. 767.
Jeannel 1942, Faune de France, Coléop. Carabiques, Part 2, p. 1017, footnote.
Pentagonicinae Basilewsky 1953, Exploration Parc National l'Upemba, Fasc. 10, p. 183.
Scopodini Csiki 1932, Coleop. Cat., Carabidae, Harpalinae 7, p. 1500 (see for synonymy and additional references).
Jedlicka 1963, Ent. Abhandlungen 28, p. 505.

The beetles of this tribe resemble Lebiini but (according to Jeannel 1949) are not related to them. Pentagonicini can usually be recognized at a glance by form, and the tribe is defined by technical characters including obliteration of the suture that, in most Carabidae, separates the mentum from the base of the head posteriorly. However, this suture is still indicated in *Parascopodes*.

This tribe consists of four genera. One, *Pentagonica*, occurs in all the warm regions of the world. One, *Parascopodes* (described below), consists of a single species that occurs in both eastern New Guinea and northeastern Australia. One, *Actenonyx* (1 species), is confined to New Zealand. And the fourth genus, *Scopodes*, is best represented in Australia and extends to New Zealand and to mountains on New Guinea and on Java. Ecologically, *Pentagonica* alone of these 4 genera is primarily arboreal, occurring especially in masses of vines and other vegetation near the ground, although some species are found among dead leaves on the ground. *Parascopodes cyaneus* occurs, in my limited experience, in grass or on the ground under grass (I am not sure which). The New Zealand genus (*Actenonyx*) is probably ground-living. And *Scopodes* is ground-living but some species occur on logs or tree trunks.

The distribution of genera of Pentagonicini suggests two possible geographic histories. The tribe may once have been better represented in other parts of the world and may have withdrawn (or may be withdrawing) into the Australian Region. Or the tribe may have originated in Australia and diversified there, and *Pentagonica* may have spread from there over the rest of the world, its spread perhaps facilitated by its invasion of arboreal habitats in which flight and dispersal may have been

favored. The very wide distributions of some species of *Pentagonica* show that the insects do disperse readily. Of course, there is a third possibility, that the geographic history of the tribe has been more complex than can be guessed from present distributions of genera and cannot now be deciphered at all. Nevertheless, the history of the tribe is worth guessing about. Its distribution may become more significant if other Carabidae or other animals are found to have similar geographic patterns. There is, for example, a suggestive general similarity between the distributions of this tribe of carabid beetles and of the parrots, which are most diverse in the Australian Region with one of the several Australian subfamilies spread over the warmer parts of the world (Darlington, *Zoogeography*, Wiley, 1957, pp. 271–272, 300–301, fig. 34).

Key to Genera of Pentagonicini of New Guinea

1. Form *Lebia*-like, with eyes only normally prominent (Fig. 118) (p. 192) *Pentagonica*
– Form more compact, with eyes larger and more abruptly prominent (Figs. 120, 121) 2
2. Ligula normal, not much swollen, much shorter than paraglossae; ♂ front tarsi 2-seriately squamulose; elytral striae and intervals regular, without conspicuous foveae (p. 195) *Parascopodes*
– Ligula swollen, club-like, as long as or longer than paraglossae; ♂ front tarsi with soles of densely packed slender squamae; elytral striae and intervals usually more or less irregular, 3rd intervals usually with conspicuous foveae (p. 197) *Scopodes*

Genus *PENTAGONICA* Schmidt-Goebel

Schmidt-Goebel 1846, Faunula Coleop. Birmaniae, p. 47.

Csiki 1932, Coleop. Cat., Carabidae, Harpalinae 7, p. 1500 (see for additional references, synonymy, and list of species).

Diagnosis. Immediately recognizable by form (Fig. 118) and tribal characters.

Description. None required here.

Type species. Pentagonica ruficollis Schmidt-Goebel (below).

Generic distribution. All warm regions of the **world**.

Notes. The members of this genus are winged, active, and apparently diurnal. They usually live in dense vegetation within a few feet of the ground, or sometimes in leaf litter on the ground. Specific characters in the genus are few, principally slight differences of form, microsculpture, and color pattern. There is some individual variation, including apparent dimorphism of color in some cases. And understanding of the species is made more difficult by the very wide distributions of some of them.

Because the prothorax has no distinct anterior angles, the ratio base/apex is omitted in the following specific descriptions.

Key to Species of *Pentagonica* of New Guinea

1. Prothorax strongly pedunculate; (bicolored, dark with prothorax red; elytral striae punctulate; size small, length 3–3.8 mm) (p. 192) *pallipes*
– Prothorax less strongly pedunculate; size usually larger 2
2. Pronotum with lateral margins usually connected posteriorly by a weak transverse ridge that is not quite basal; reticulate microsculpture of elytra often somewhat transverse; (color above uniformly dark or with prothorax red; length *c.* 3.5–4.5 mm) (p. 193) *blanda*
– Pronotum with lateral margins connected posteriorly by a fine ridge that reaches extreme base; elytral microreticulation usually *c.* isodiametric; size larger 3
3. Prothorax relatively narrower (width/length 1.57 and 1.65); (color dark, with lateral margins of prothorax and elytra strikingly pale) (p. 194) *erichsoni*
– Prothorax relatively wider (width/length 1.72–1.79) 4
4. Bicolored, dark with red prothorax (p. 194) *ruficollis*
– Not bicolored, entirely dark 5
5. Elytral striae clearly indicated (but scarcely impressed); antennae relatively dark and femora relatively pale (p. 194) *papua*
– Elytral striae virtually obsolete; antennae testaceous, femora relatively dark (p. 195) *estriata*

Pentagonica pallipes (Nietner)

Nietner 1856, J. Asiatic Soc. Bengal 25, p. 525 (*Elliotia*).

Csiki 1932, Coleop. Cat., Carabidae, Harpalinae 7, p. 1502 (see for synonymy and additional references).

Jedlicka 1963, Ent. Abhandlungen 28, pp. 505, 507.

Description (for recognition only). Head and elytra dark, prothorax red. *Head* 0.91 and 0.93 width prothorax. *Prothorax* pedunculate; width/length 1.71 and 1.59. *Elytra*: width elytra/prothorax 1.62 and 1.79; striae punctate; reticulate microsculpture slightly irregular but scarcely transverse. *Measurements*: length 3.0–3.8; width *c.* 1.5–1.9 mm.

Type. From **Ceylon**; should be in Stettin Mus. (not seen).

Occurrence in New Guinea. Nineteen specimens from all 3 political divisions of **New Guinea**; most from low altitudes (including Oro Bay near Dobodura) but 2 at 1200 m at Wau. One specimen (from Wau) is labeled as taken at light.

Measured specimens. A ♂ from Hollandia and ♀ from Port Moresby.

Notes. The known range of this relatively distinct species is from **Ceylon**, the **Malay Pen.,** etc., to the **Philippines**, **New Guinea**, **New Britain**, and mid-peninsular Cape York, **Australia** (collected by me in 1958).

Pentagonica blanda Andrewes

Andrewes 1929, Tijdschrift voor Ent. 72, pp. 315, 339.
?*luzoensis* Jedlicka 1934, Sbornik Ent. Mus. Prague 12, p. 123.
?*philippinensis* Jedlicka 1934, Sbornik Ent. Mus. Prague 12, p. 124.
?*bottcheri* Jedlicka 1935, Acta Soc. Ent. Czechoslovakia 32, p. 140.
?*euryodes* Andrewes 1938, Ann. Mag. Nat. Hist. (11) 1, p. 207.
?*quadratipennis* Louwerens 1956, Treubia 23, p. 236.

Description (for recognition only). Form (Fig. 118) broad; color above *either* entirely dark *or* dark with red or reddish prothorax; antennae brown or testaceous; legs pale, often with darker femora. *Head* 0.77 and 0.74 width prothorax. *Prothorax*: width/length 1.83 and 1.80; lateral margins usually connected by a poorly defined (sometimes vague) transverse *pre*basal ridge. *Elytra*: width elytra/prothorax 1.51 and 1.54; sutural angles usually blunted or narrowly rounded but sometimes denticulate; striae lightly impressed, usually finely punctulate (but variable); reticulate microsculpture often ± transverse. *Measurements*: length *c.* 3.5–4.5; width *c.* 1.6–1.8 mm.

Types. Of *blanda*, from **Sumatra**, in British Mus. (seen); of Jedlicka's species, from the **Philippines**, types of *luzoensis* and *philippinensis* in Jedlicka Coll. (not seen), of *bottcheri*, in British Mus. (seen); of *euryodes*, from **Java**, in British Mus. (seen); of *quadratipennis*, from Halmahera, **Moluccas**, in Leiden Mus. (not seen).

Occurrence in New Guinea. Very common throughout **New Guinea**: *c.* 130 specimens (about half from Dobodura), most at low altitudes but a few up to 2500 m (at 1200 m at Wau).

Measured specimens. A pair (♂ ♀) from Dobodura.

Notes. I am not ready to synonymize the names listed above under *blanda*, but I suggest that they *may* all prove to apply to a single variable species or to members of a group of very closely interrelated species that ranges from **SE. Asia** across the **Malay Archipelago** to **NE. Australia**. This species or species group varies strikingly in color pattern (individuals unicolored or bicolored) and to some extent in proportions, size, degree of paleness of margins and appendages, and distinctness of punctures of elytral striae. Most individuals from New Guinea are entirely dark above, but 3 from Finschhafen, N-E. N. G., and 8 from Hollandia, West N. G., have the prothorax red. These superficially resemble *ruficollis* (second following species), but have different prothoracic bases, usually rounded sutural angles, and ± transverse elytral microsculpture. Except for the red prothorax, these individuals do not seem to differ from specimens with dark prothorax taken at the same localities. At these localities the species is apparently dimorphic in color of prothorax. However, at some other localities intermediates oc-

cur: 4 examples that I have from Sansapor (Vogelkop), West N. G., have the prothorax paler than head and elytra but reddish brown rather than clear red. Obviously this species or group of species requires further study, of material from outside as well as inside New Guinea, before its variation can be understood.

Most of the many specimens that I collected in New Guinea were taken by day, by sweeping low vegetation. However, a few individuals, including both color forms at Finschhafen, are from light-trap material and evidently flew to light at night.

I collected numerous dark (not bicolored) specimens apparently of this species at several localities in North Queensland in 1957–1958. The species seems not to have received a name in Australia.

Pentagonica erichsoni Schmidt-Goebel

Schmidt-Goebel 1846, Faunula Coleop. Birmaniae, p. 48.
Csiki 1932, Coleop. Cat., Carabidae, Harpalinae 7, p. 1501 (see for synonymy and additional references).
Jedlicka 1963, Ent. Abhandlungen 28, pp. 506, 511.

Description (for recognition only). Form of large *Pentagonica* with rather narrow prothorax; dull black, reflexed margins of prothorax and elytra very pale or translucent, legs testaceous, antennae brown. *Head* 0.85 and 0.84 width prothorax. *Prothorax*: width/length 1.57 and 1.65; margins posteriorly connected by a fine curved ridge across extreme base. *Elytra*: width elytra/prothorax 1.82 and 1.78; sutural angles usually denticulate; striae slightly impressed, vaguely or not distinctly punctate; elytral microreticulation *c.* isodiametric. *Measurements*: length *c.* 5.0–5.5; width *c.* 2.0–2.2 mm.

Type. From Burma; in Prague Mus. (not seen).

Occurrence in New Guinea. **Papua**: 1, Dobodura, Mar.–July 1944 (Darlington); 1, Woodlark Is. (Murua), Kulumadau Hill, Apr. 20–30, 1957 (W. W. Brandt, Bishop Mus.). **N-E. N. G.**: 1, Simbang, Huon Gulf, 1898 (Biró); 1, Wau, 1200 m, Sept. 15–30, 1962 (Sedlacek); 1, Wum, Upper Jimmi Vy., 840 m, July 16, 1955 (Gressitt).

Measured specimens. Two ♀♀, from Dobodura and Wum.

Notes. *P. erichsoni* ranges from **Ceylon** and **SE. Asia** to **New Guinea** and mid-peninsular Cape York, **Australia** (1 specimen, Rocky R., 1958, taken by myself).

Pentagonica ruficollis Schmidt-Goebel

Schmidt-Goebel 1846, Faunula Coleop. Birmaniae, p. 48.
Csiki 1932, Coleop. Cat., Carabidae, Harpalinae 7, p. 1503.
Jedlicka 1963, Ent. Abhandlungen 28, p. 509.

Description (for recognition only). Form of large *Pentagonica*; black, prothorax red, appendages usually black or brown. *Head* 0.81 and 0.77 width prothorax. *Prothorax*: width/length 1.79 and 1.78. *Elytra*: width elytra/prothorax 1.59 and 1.61; sutural angles usually denticulate; striae very light or *c.* absent; microsculpture *c.* isodiametric. *Measurements*: length *c.* 5.0–5.7; width *c.* 2.0–2.3 mm.

Type. From **Burma**, should be in Prague Mus. (not seen).

Occurrence in New Guinea. Twenty-six specimens from **Papua**, **N-E. N. G.**, and **West N. G.**, at low altitudes and up to 1950 m.

Measured specimens. A pair (♂♀) from Dobodura, Papua.

Notes. The known range of *ruficollis* is from **SE. Asia** to **Australia**.

Pentagonica papua n. sp.

Description. Form (Fig. 119) of large, rather slender *Pentagonica*; entirely black or piceous except suture sometimes reddish, margins sometimes reddish but not contrastingly pale; femora brown, tibiae and tarsi testaceous; antennae brown with 1st segments darker brown; reticulate microsculpture isodiametric on head and pronotum, more irregular or slightly transverse on elytra. *Head* 0.78 and 0.78 width prothorax; labrum transverse, 6-setose ante-

riorly, the 4 inner setae much smaller than outer ones; mentum without tooth; ligula not much swollen, 2-setose; paraglossae slightly shorter than ligula and apparently attached to it. *Prothorax*: width/length 1.73 and 1.72; margins posteriorly connected by *basal* loop. *Elytra*: width elytra/prothorax 1.63 and 1.63; sutural angles usually narrowly rounded, not denticulate; striae very finely and lightly indicated, scarcely impressed, irregularly punctulate; 3rd intervals apparently usually with 3 minute, well spaced punctures but latter small, difficult to find, perhaps sometimes absent. *Secondary sexual characters*: ♂ front tarsi scarcely dilated but with slender squamae in 2 slightly irregular rows; ♂ with 1, ♀ 2 setae each side last ventral segment. *Measurements*: length 4.8–5.7; width 1.8–2.2 mm.

Types. Holotype ♂ (M.C.Z., Type No. 31,495) and 10 paratypes all from Dobodura, **Papua**, Mar.–July 1944 (Darlington).

Measured specimens. The ♂ holotype and 1 ♀ paratype.

Notes. The preceding *Description* gives all the characters that seem to me worth mentioning in this genus, in which the species are so similar to each other. The particular characters that separate this species from others in New Guinea are indicated in the *Key to Species*. The present new species is larger than *blanda*, relatively narrower, with different pronotal base and slightly different elytral microsculpture, as well as more lightly impressed elytral striae. As compared with *erichsoni*, *papua* has a wider prothorax, shallower elytral striae, and darker prothoracic and elytral margins. The closest relative of *papua* may be *ruficollis* (above), but the latter is bicolored and always (in the specimens before me) has the sutural angles subdenticulate or at least angulate, while *papua* is dark, with sutural angles usually blunted, rarely subdenticulate. The difference in sutural angles is not absolute but is enough to suggest that the color difference is specific.

Pentagonica estriata n. sp.

Description. Form of large *Pentagonica*; black or piceous, legs dark, antennae including basal segments pale; entire upper surface with *c.* isodiametric microsculpture, at most slightly transverse on elytra. *Head* 0.83 and 0.82 width prothorax; details of mouthparts as in *papua*. *Prothorax*: width/length 1.76 and 1.78; margins posteriorly connected by a *basal* loop. *Elytra*: width elytra/prothorax 1.71 and 1.74; sutural angles usually finely denticulate; striae effaced or at most faintly indicated; dorsal punctures, if present, minute, almost undetectable. *Secondary sexual characters* as in preceding species (*papua*). *Measurements*: length 4.9–6.2; width 2.1–2.6 mm.

Types. Holotype ♂ (Bishop Mus.) and 1 ♀ paratype from Eliptamin Vy., **N-E. N. G.**, 1200–1350 m, June 19–30, 1959 (W. W. Brandt); and additional paratypes as follows. **N-E. N. G.**: 1, Eliptamin Vy., 1350–1665 m, June 23–30, 1959 (W. W. Brandt, Bishop Mus.); 1, Wau, Morobe Dist., 1200 m, Jan. 3–4, 1963 (Sedlacek); 1, "No. 14," Umi R., Markham Vy., 480 m, Nov. 11, 1959 (L. J. Brass, A.M.N.H.). **West N. G.**: 1, Hollandia, Dec. 15, 1944 (Hoogstraal, M.C.Z.); 1, Star Mts., Sibil Vy., 1245 m, Oct. 18–Nov. 8, 1961 (S. & L. Quate, Bishop Mus.), taken in Malaise trap; 3, Japen Is., Mt. Baduri, 1000 ft. (*c.* 300 m), Aug. 1938 (Cheesman). Some paratypes in M.C.Z., Type No. 31,496.

Measured specimens. The ♂ holotype and 1 ♀ paratype from Eliptamin Vy.

Notes. P. estriata is the same size and nearly the same form as *papua* but slightly broader, with differently colored appendages, usually denticulate rather than blunted sutural angles, and virtually no elytral striae. The latter character, as well as color, differentiates *estriata* from *ruficollis*.

PARASCOPODES n. gen.

Diagnosis. Form *Scopodes*-like. *Head*: eyes enormous; labrum transverse-quadrate, 6-setose; mentum with basal suture in-

dicated, and with broad, short, more or less emarginate tooth; ligula not swollen, 2-setose; paraglossae much longer than ligula, with apices narrowly rounded. *Prothorax* weakly subpedunculate, angulate at sides, 2-setose each side. *Elytra* with entire, regular striae; 3rd intervals very inconspicuously 3-punctate. *Secondary sexual characters*: ♂ front tarsi narrow, 2-seriately squamulose below; ♂ copulatory organs as figured (Fig. 178); most other characters as in *Scopodes* (below).

Description. See *Diagnosis* (above) and *Description* of the single species (below).

Type species. Scopodes cyaneus Sloane.

Generic distribution. As of the single known species: eastern **New Guinea** and North Queensland, **Australia**.

Notes. Although the *Scopodes*-like form and enormous eyes are striking specializations, the labrum, mentum, ligula, elytra, and perhaps the ♂ tarsi of *Parascopodes cyaneus* seem generalized within the tribe and suggest that the insect may be a superficially specialized relict of a primitive stock from which both *Pentagonica* and *Scopodes* may have evolved.

Parascopodes cyaneus (Sloane)

Scopodes cyaneus Sloane 1907, Proc. Linnean Soc. New South Wales 32, p. 380.

Description. With characters of genus; form as in Figure 120; color above blue, more or less purplish on elytra, below piceous; appendages testaceous, mouthparts in part browner; shining, reticulate microsculpture virtually absent on head, light, irregular, usually slightly transverse on pronotum and elytra. *Head* 1.36, 1.32, 1.31 width prothorax; 2 setae over each eye; front smooth at middle, with a deep groove each side. *Prothorax*: width/length 1.19, 1.16, 1.23; margins narrow, each with 2 setae on small projections; disc strongly convex; middle line and transverse impressions sharply impressed, latter irregularly subpunctate; surface of disc smooth except with faint transverse strigulation toward sides. *Elytra*: width elytra/prothorax 1.72, 1.72, 1.65; striae entire, regular, coarsely punctate; intervals regular, flat or slightly convex, 3rd with 3 very inconspicuous dorsal punctures (see *Notes*, below). *Inner wings* dimorphic: short in 1 ♂ from Dobodura, full in all other specimens. *Lower surface* sparsely pubescent; base of abdomen on each side (under bases of femora) with *c.* 6 parallel grooves that *may* form a stridulating organ. *Legs* slender; 4th hind-tarsal segments shallowly emarginate; 5th segments with accessory setae; claws simple. *Secondary sexual characters*: ♂ tarsi as described under genus; ♂ with 1, ♀ 2 setae each side last ventral segment. *Measurements*: length 3.7–4.0; width 1.4–1.6 mm.

Type. From Kuranda, North Queensland, **Australia**; should be in Sloane Coll., Canberra, but I was not able to find it there in 1957.

Occurrence in New Guinea. **Papua**: 3, Dobodura, Mar.–July 1944 (Darlington); 1, Misima Is. ("St. Aignan") (ex coll. E. C. Morrell, British Mus.). Also 1, "New Guinea, Sayer" (Sharp Coll., British Mus.).

Measured specimens. A pair (♂ ♀) from Dobodura and a ♀ from N. of Mareeba, Australia (see below); figures listed in this order.

Notes. Besides the specimens from New Guinea, I have 1 ♀ taken by myself N. of Mareeba (about 20 miles SW. of the type locality), North Queensland, Australia, Feb. 1958, in flooded grassland. I can find no significant difference between the New Guinean and Australian specimens, but of course I have not been able to compare ♂ characters.

In a footnote to the original description, Sloane says that he could find only 1 (fine) dorsal puncture on the elytra of the type. However, under a good stereoscopic microscope with good light, I find what appear to be 3 punctures nearly evenly spaced along the length of each 3rd interval in both New Guinean and Australian individuals.

The habitat of this species, in or under grass at low altitudes, is different from that of any *Scopodes* in New Guinea. *If* this insect is a relict of an ancestral stock from which *Pentagonica* and *Scopodes* have evolved, as I have suggested under the genus, it may still be in an ancestral habitat from which *Pentagonica* may have invaded low vegetation, and *Scopodes*, habitats on the ground.

Genus *SCOPODES* Erichson

Erichson 1842, Archiv für Naturgeschichte 8, Band 1, p. 123.

Sloane 1903, Proc. Linnean Soc. New South Wales 28, pp. 637–638 (key to Australian species).

Csiki 1932, Coleop. Cat., Carabidae, Harpalinae 7, p. 1504 (see for additional references, synonymy, and list of species).

Diagnosis. Form (Fig. 121) characteristic, with eyes very large and sides of prothorax usually angulate; mentum not toothed; ligula swollen, club-like, longer than paraglossae, 2-setose; ♂ front tarsi with soles of numerous close-packed slender squamae not in 2 series. For additional diagnostic characters see under the tribe and *Key to Genera of Pentagonicini.*

Description. None required here, but note wings full or reduced or dimorphic in different Australian species, full in all New Guinean species except *altus*, in which reduced.

Type species. Scopodes boops Erichson, of southern Australia.

Generic distribution. **Australia**, **New Zealand**, **New Guinea**, **Java**; and 1 species (not seen by me) described from **New Caledonia**.

Notes. This genus divides into 2 groups. The typical group includes all the Australian and New Zealand species, 1 species (*altus*) at very high altitudes on the Snow Mts. in New Guinea, and 1 (*irregularis* Andrewes) on mountains in Java. The other New Guinean members of the genus form a distinct, endemic group of relatively compact, often brightly colored species occurring mostly at moderate altitudes in the mountains. These species can be arranged in what seems to be an evolutionary sequence involving change of form, loss of elytral striae, simplification and reduction of sculpture, and intensification of color, but the lines of evolution have probably been complex. In the last species of the *Key* (*adonis*, Fig. 123), which is at the end of the apparent evolutionary sequence, the *Scopodes* form is much modified (the prothorax being long and narrow and without lateral angulations, and the elytra being oval); the elytral striae and sculpture have almost disappeared, and the color is deep purple.

These beetles live in the ground or in logs. They are probably diurnal: most of them are winged, but they apparently do not come to light at night. Evelyn Cheesman, in *The Land of the Red Bird* (London, Herbert Joseph Ltd., no date, p. 134), says apparently of *Scopodes cheesmani* (which I describe below), "Other insects were very tiny violet beetles, which appeared from inside the log, out of one of its many passage ways, and ran about on the surface." This was between 3400 and 4500 ft. (*c.* 1380 m) altitude in the rain-forested Cyclops Mts.

In the following descriptions, the width of prothorax includes the tubercles. The frontal sulci are counted between the eyes just behind the anterior supraocular setae. The sculpture of the front of the head, especially of the clypeus, is variable, heavily impressed or almost obsolete in different individuals of single species from single localities, and I have therefore not described it in detail in most cases.

Key to Species of *Scopodes* of New Guinea

1. Prothorax with 2 setae each side, the posterior on conspicuous dentiform processes; (depressed; elytra with *c.* complete striation indicated) (p. 198) ..... *altus*
– Prothorax with only 1 seta each side, *c.* ⅓ of prothoracic length from apex, without posterior-lateral setae or processes 2

2. Elytra with conspicuous irregular sericeous pattern *and* extensively but irregularly striate 3
– Elytra without conspicuous sericeous pattern 4
3. Color bronze, elytral foveae conspicuously blue, legs pale (p. 199) ..... *tafa*
– Color dark bronze or greenish, elytral foveae not conspicuously contrasting, legs dark (p. 199) ..... *chimbu*
4. Color usually bronze, never primarily bright blue or purple 5
– Color primarily blue or purple 7
5. Elytra with striae indicated at least anteriorly 6
– Elytra without striae (p. 201) ..... *simplex*
6. Extensively substriate (p. 200) ..... *wilsoni*
– Striae indicated only at base of elytra (p. 200) ..... *basalis*
7. Prothorax with lateral margins (p. 201) ..... *cheesmani*
– Prothorax without lateral margins (p. 201) ..... *adonis*

Scopodes altus n. sp.

Description. With characters of genus; form (Fig. 121) relatively depressed, with humeri narrowed; black, appendages dark; rather shining, but complexly sculptured as described below. *Head* 1.26 and 1.23 width prothorax; labrum long, strongly rounded, with 4 decurved setae anteriorly, the inner setae much shorter than the outer (setae sometimes broken off); front with *c.* 20 or more fine sulci, latter subparallel at sides and base but connected and partly transverse at middle of head; front anteriorly and clypeus and labrum more finely and closely longitudinally sculptured in ♂ ♂, sculpturing reduced in ♀ (see *Notes*). *Prothorax*: width/length 1.24 and 1.27; sides margined, each with 2 setae, at angulation *c.* ⅓ from apex and on conspicuous triangular process before base; disc with weak median longitudinal impression and strong subbasal and subapical transverse impressions; surface of disc covered with rather fine, complex, more or less anastomosing sculpture. *Elytra*: width elytra/prothorax 1.69 and — (elytra too spread to measure in ♀); striae indicated by undulations of the surface but not sharply defined, slightly irregular; intervals slightly convex, 3rd with 3 moderate foveae; elytral surface with rather light irregular reticulate microsculpture. *Inner wings* reduced to *c.* ½ length of elytra. *Measurements*: length *c.* 3.3–3.5; width *c.* 1.3 mm.

Types. Holotype ♂ (Leiden Mus.) from Scree Vy. Camp, Snow Mts., **West N. G.**, 3600 m, Sept. 19, 1938; 1 ♂ paratype (M.C.Z., Type No. 31,497) from same locality, 3800 m, Sept. 1938; 1 ♀ paratype (Leiden Mus.), from Lake Habbema, Snow Mts., 3250–3300 m, late July–Aug. 1938 (all specimens collected by Toxopeus).

Measured specimens. The ♂ holotype and ♀ paratype.

Notes. This species differs from all other *Scopodes* known from New Guinea in its depressed form and in possessing 2 pairs of lateral prothoracic setae. In these ways it resembles some Australian species including the type of the genus, *Scopodes boops* Erichson, but *altus* is more shining than *boops*, with better defined pronotal sculpture, and other minor differences of detail. *S. altus* resembles also *irregularis* Andrewes of Java but is black rather than aeneous, with elytra less narrowed anteriorly and more distinctly striate, as shown by comparison with a specimen of *irregularis* from "G. Tengger, Java, Drescher." Of the 3 species just discussed, the Australian *boops* has dimorphic wings; the New Guinean and Javan species, reduced ones; but they all are probably derived from a winged ancestor that dispersed by flight. The distribution of this group of *Scopodes* in the Malay Archipelago is comparable to that of *Mecyclothorax*, which also occurs primarily in Australia but is represented at very high altitudes on the Snow Mts. of New Guinea and on the mountains of Java (Darlington, Bull. M.C.Z. 126, 1962, pp. 505–507). See also *Microferonia*, page 18 of my present paper.

Whether the difference in sculpture of clypeus and labrum of the ♂ ♂ (Scree Vy.) and the ♀ (Lake Habbema) is sexual,

geographic, or individual cannot be decided without more material.

Scopodes tafa n. sp.

Description. With characters of genus; form compact, convex; aeneous, labrum dark, dorsal and lateral foveae of elytra blue, appendages pale, antennae browner distally; head and pronotum shining, sculptured as described (below), elytra irregularly sericeous with irregular reticulate microsculpture. *Head* 1.19 and 1.20 width prothorax; labrum rounded, 6-setose; front with *c.* 8 longitudinal sulci abbreviated anteriorly and running into coarse rugosity posteriorly; labrum more finely longitudinally rugose. *Prothorax*: width/length 1.26 and 1.27; sides margined, each with seta-bearing puncture on triangular process at angulation *c.* ⅓ from apex; disc with coarse rugosity transverse posteriorly but more confused anteriorly. *Elytra* subquadrate; width elytra/prothorax 1.83 and 1.77; several striae indicated on disc but striation obsolete externally and apically; 3rd interval conspicuously 3-foveate. *Measurements*: length 3.5–4.0; width 1.4–1.7 mm.

Types. Holotype ♀ (British Mus.) and 4 paratypes (2 in M.C.Z., Type No. 31,498) all from Mt. Tafa, **Papua**, 8500 ft. (*c.* 2600 m), Feb. 1934 (Cheesman).

Additional material. One ♀, Wau, Bulldog Rd., **N-E. N. G.,** 2400 m, May 31, 1962 (Sedlaceks).

Measured specimens. The ♂ holotype and 1 ♀ paratype.

Notes. See preceding *Key* for characters distinguishing this from related species. The specimen from Wau is slightly larger than the types, with narrower humeri (but still with large folded inner wings) and less distinct elytral striation. Additional material may show it to be a distinguishable form.

Scopodes chimbu n. sp.

Description. With characters of genus; form compact; color dark, subaeneous or greenish, elytral foveae not contrasting, appendages dark except antennae paler basally; head and pronotum sculptured but with irregular reticulate microsculpture. *Head* 1.15 and 1.22 width prothorax; labrum rounded, 6-setose; front with *c.* 7 longitudinal sometimes slightly sinuous sulci shining, elytra irregularly sericeous and running into coarse rugosity posteriorly and sometimes anteriorly. *Prothorax*: width/length 1.25 and 1.21; sides margined, each with 1 seta-bearing puncture, on tubercle at angulation *c.* ⅓ from apex; disc coarsely rugose, the rugosity in general transverse but somewhat confused especially anteriorly. *Elytra* subquadrate; width elytra/prothorax — and 1.83 (elytra of ♂ too spread to measure); several striae indicated on disc, outer striae fainter or obsolete; 3 conspicuous foveae on each 3rd interval. *Measurements*: length 3.5–4.4; width 1.4–1.7 mm.

Types. Holotype ♂ (M.C.Z., Type No. 31,499) and 2 (♀ ♀) paratypes from Chimbu Vy., Bismarck Rge., **N-E. N. G.,** 5000–7000 ft. (*c.* 1500–2135 m), Oct. 1944 (Darlington).

Additional material. N-E. N. G.: 2, Mt. Mis(s)im, Morobe Dist. (1 specimen at 6400 ft. = 1950 m) (Stevens, M.C.Z.); 1, Joangang, 500 m, Apr. 7–8, and 1, Tumnang, 1400–1600 m, Apr. 14–15, both on Mongi Watershed, Huon Pen. (1955, E. O. Wilson, M.C.Z.); 1, Saruwaged (Salawaket) Rge., upper Bunbok Vy., 1800–2000 m, May 1955 (E. O. Wilson, M.C.Z.); 1, Sepalakembang, Salawaket Rge., 1920 m, Sept. 12, 1956 (E. J. Ford, Jr., Bishop Mus.); 1, Kepilam, 2420–2540 m, June 21, 1963 (Sedlacek); 1, Finisterre Rge., Saidor, Matoko, Aug. 29–Sept. 5, 1958 (W. W. Brandt, Bishop Mus.).

Measured specimens. The ♂ holotype and 1 ♀ paratype.

Notes. This species varies somewhat from locality to locality, but I do not have enough material to distinguish geographic forms. Except that my specimens were taken on the ground in the more open part of the

Chimbu Valley, I can say nothing about their habits.

Scopodes wilsoni n. sp.

Description. With characters of genus; compact, convex; color dark, subaeneous, elytral foveae not contrasting, appendages dark, antennae paler basally; shining, head and pronotum coarsely sculptured, elytra irregularly microreticulate but without conspicuous sericeous pattern. *Head* 1.25 and 1.24 width prothorax; labrum narrowly rounded, 6-setose; front with *c.* 8 longitudinal sulci running into coarse rugosity posteriorly and usually anteriorly. *Prothorax*: width/length 1.23 and 1.18; sides margined, each with seta-bearing puncture on tubercle at angulation *c.* ⅓ from apex; disc coarsely rugose, the rugosity transverse but somewhat irregular and varying in depth, and disc also variably punctulate. *Elytra* quadrate; width elytra/prothorax 1.91 and— (elytra too spread to measure in second specimen); all or several striae indicated for much of length; 3 conspicuous foveae on or near each 3rd interval. *Measurements*: length 3.4–4.1; width 1.4–1.7 mm.

Types. Holotype ♂ (M.C.Z., Type No. 31,500) from Nganduo to Yunzain, Mongi Watershed, Huon Pen., **N-E. N. G.,** 1000–1500 m, Apr. 6, 1955 (E. O. Wilson); and following paratypes (all ♂ ♂) from N-E. N. G.: 1, Nadzab, Markham Vy., July 13, 1944 (K. V. Krombein, U.S.N.M.), this specimen further labeled "E. fork Ngafir Cr. 1000–3000 ft. native trail"; 1, Mt. Mis(s)im, Morobe Dist., 6400 ft. (1950 m) (Stevens, M.C.Z.); 1, Wau, 1300 m, Dec. 10, and 1, same locality, Nami Ck., 1750 m, Aug. 12 (both 1961, Sedlaceks).

Additional material. **Papua**: 1, Owen Stanley Rge., Goilala, Bome, 1950 m, Apr. 30–May 2, 1958 (W. W. Brandt, Bishop Mus.). **West N. G.**: 1, Rattan Camp, 1150 m, Feb.–Mar., and 1, Sigi Camp, 1500 m, Feb. 26, both 1959 (Neth. Ind.-American [Snow Mts.] Exp.; Toxopeus).

Measured specimens. The ♂ holotype and ♀ paratype from Nadzab.

Notes. As in the case of *chimbu* (preceding), this species appears to vary geographically, but my material is too limited to justify describing geographic forms.

Scopodes basalis n. sp.

Description. With characters of genus; very compact, convex; dark green or aeneous, elytral foveae not contrasting, labrum and legs dark, antennae yellowish brown; shining, reticulate microsculpture faint or absent even on elytra. *Head* 1.22 and 1.20 width prothorax; labrum narrowly rounded, 6-setose; front with *c.* 7 longitudinal sulci sometimes abbreviated anteriorly and posteriorly. *Prothorax*: width/length 1.21 and 1.25; sides margined, each with seta-bearing puncture on tubercle at angulation *c.* ⅓ from apex; disc coarsely transversely rugose (rugosity sometimes only lightly impressed) and rather sparsely finely punctulate. *Elytra* quadrate; width elytra/prothorax 1.79 and 1.82; striae absent or virtually so except deeply but variably impressed at base, sometimes only on basal declivity; 3 conspicuous punctiform foveae on positions of 3rd intervals. *Measurements*: length *c.* 3.3; width *c.* 1.7 mm.

Types. Holotype ♂ (M.C.Z., Type No. 31,501) from Joangang, Mongi Watershed, Huon Pen., **N-E. N. G.,** 500 m, Apr. 7–8, 1955 (E. O. Wilson); and following paratypes from **N-E. N. G.**: 1, Saruwaged (Salawaket) Rge., upper Bunbok Vy., 2300–3200 m, May 29–31 (E. O. Wilson, M.C.Z.), "mossy forest"; 1, Mt. Mis(s)im, Morobe Dist. (Stevens, M.C.Z.); 1, Torricelli Mts., Siaute, sea level, Nov. 9–17, 1958 (W. W. Brandt, Bishop Mus.).

Measured specimens. The ♂ holotype and ♀ paratype from Saruwaged Rge.

Notes. S. basalis differs from *wilsoni* not only in reduction of elytral striation but also in more punctiform elytral foveae and virtual absence of reticulate microsculpture of elytra. The occurrence of an individual near sea level is unusual in this genus in New Guinea.

Scopodes simplex n. sp.

Description. With characters of genus; compact, convex; aeneous black, elytra sometimes *faintly* purplish, front anteriorly, clypeus, and labrum bright aeneous, appendages dark, base of antennae paler; shining, elytra lightly irregularly microreticulate. *Head* 1.25 and 1.25 width prothorax; front with 7 sulci running into coarse rugosity posteriorly and sometimes anteriorly. *Prothorax*: width/length 1.19 and 1.22; sides margined, each with seta on tubercle *c.* ⅓ from apex; disc lightly transversely wrinkled, ± punctulate (variable). *Elytra* subquadrate; width elytra/prothorax 1.90 and 1.92; disc virtually estriate, with 3 conspicuous punctiform foveae near position of each 3rd interval. *Measurements*: length 3.8–4.2; width 1.5–1.7 mm.

Types. Holotype ♂ (M.C.Z., Type No. 31,502) and 2 paratypes from Nganduo to Yunzain, Mongi Watershed, Huon Pen., **N-E. N. G.,** 1000–1500 m, Apr. 6, 1955 (E. O. Wilson); and additional paratypes as follows. **N-E. N. G.**: 1, Gemeheng, Mongi Watershed, Huon Pen., 1300 m, Apr. 11–13, 1955 (E. O. Wilson, M.C.Z.); 1, vic. Nadzab, July 1944 (Darlington); 2, Sattelberg (British Mus., ex Coll. Hauser). **West N. G.**: 8, Wissel Lakes, Moanemani, Kamo Vy., 1500 m, Aug. 14, 1962 (Sedlacek); 2, Wissel Lakes, Enarotadi, 1500 m, Aug. 14, 1962 (Sedlacek).

Measured specimens. The ♂ holotype and 1 ♀ paratype from Nganduo to Yunzain.

Notes. This species, like the preceding (*basalis*), occurs at relatively low altitudes, sometimes down almost to sea level (at Nadzab).

Scopodes cheesmani n. sp.

Description. With characters of genus; form (Fig. 122) compact, convex; blue-purple (in general blue with elytra purple with foveae bluer); shining, reticulate microsculpture faint or obsolete even on elytra. *Head* 1.31 and 1.35 width prothorax; front with 7 sulci running into coarsely rugose areas posteriorly and usually anteriorly. *Prothorax* narrower and less angulate than usual; width/length 1.13 and 1.18; sides margined, each with seta on small projection *c.* ⅓ from apex; disc coarsely transversely sulcate or wrinkled, ± punctulate especially anteriorly. *Elytra* subquadrate, slightly narrowed toward base; width elytra/prothorax 1.98 and 2.09; disc estriate, with 3 conspicuous punctiform foveae on position of each 3rd interval. *Measurements*: length 3.9–4.4; width 1.6–1.8 mm.

Types. Holotype ♂ (British Mus.) and 2 paratypes from Mt. Lina, Cyclops Mts., **West N. G.,** 3500 ft. (1067 m), Mar. 1936 (Cheesman); and additional paratypes as follows. **West N. G.**: 4, Cyclops Mts., 3400–4500 ft. (*c.* 1040–1370 m), Mar. 1936 (Cheesman); 3, Rattan Camp, 1150 m, Feb.–Mar., and 1, Sigi Camp, 1350 m, Snow Mts., Feb. 28, 1939 (Toxopeus); 1, Bivak 36, 1220 m, July 30, and 1, Bivak 39, 1300 m, June 30, 1959, Star Rge. (Neth. New Guinea Exp., Leiden Mus.). **N-E. N. G.**: 1, Chimbu Vy., Bismarck Rge., 5000–7500 ft. (*c.* 1500–2300 m), Oct. 1944 (Darlington); 1, Eliptamin Vy., 1665–2530 m, June 23–30, 1959 (W. W. Brandt, Bishop Mus.). Some paratypes in M.C.Z., Type No. 31,503.

Measured specimens. The ♂ holotype and 1 ♀ paratype from Mt. Lina.

Notes. Although not very different in form and basic structure from the several preceding compact species, *cheesmani* does suggest transition toward the following (*adonis*).

The habits of this species are suggested in *Notes* under the genus.

Scopodes adonis n. sp.

Description. With characters of genus; form (Fig. 123) less compact, with longer prothorax and more oval elytra, than in other members of the "New Guinean group" of *Scopodes*; purple; front anteriorly, clypeus, and labrum cupreous; legs dark; antennae with basal and outer segments brown, segments 2–5 paler; shining, upper

surface without reticulate microsculpture, sparsely punctulate. *Head* 1.37 and 1.32 width prothorax; front with *c.* 7 slightly unequal sulci behind level of anterior supraocular punctures, the sulci abbreviated anteriorly and curving toward sides posteriorly; neck irregularly rugose. *Prothorax* oval, long; width/length 0.93 and 0.96; sides not margined, not angulate, each with seta-bearing puncture *c.* ⅓ from apex; disc strongly convex, with fine but distinct middle line, weakly transversely wrinkled. *Elytra* suboval; width elytra/prothorax 2.13 and 2.17; humeri narrower and more broadly rounded than in other species of group; outer-apical angles obtusely angulate, sutural angles acute; striae absent; 3 minute, inconspicuous seta-bearing punctures on position of each 3rd interval. *Measurements*: length 4.7–4.9; width 1.7–1.9 mm.

Types. Holotype ♂ (Bishop Mus.) and 8 paratypes (some in M.C.Z., Type No. 31,504) from Torricelli Mts., Mokai Village, **N-E. N. G.,** 750 m, Dec. 8, 16 (holotype, Dec. 8), 1958 (W. W. Brandt); and 2 paratypes, Torricelli Mts., Mobitei, 750 m, Feb. 28–Mar. 4 and Apr. 1–15, 1959 (W. W. Brandt, Bishop Mus.).

Measured specimens. The ♂ holotype and 1 ♀ paratype from Mokai Village.

Notes. This very distinct species is distinguished from all others known to me by form, prothorax long with margins obsolete, elytra oval with acute sutural angles, elytral foveae reduced, and color. However, as noted in discussion under the genus, it probably does not represent a separate stock in New Guinea but seems to be at the end of an evolutionary sequence which includes other New Guinean species.

Tribe HEXAGONIINI

Csiki 1932, Coleop. Cat., Carabidae, Harpalinae 7, p. 1506 (see for synonymy and additional references).

Hexagoniitae Jeannel 1948, Coléop. Carabiques de la Région Malgache, Part 2, p. 759.

This is a small tribe (4 genera) of characteristically formed (Fig. 124), subparallel, often flattened carabids at least some of which are specialized to live under the leaf sheaths of plants. In this tribe the inner lobe of the maxilla has a slender, *movable* apical segment that is diagnostic, occurring in no other Carabidae except the Cicindelinae.

The tribe is confined to the Old-World tropics. The genus *Hexagonia* (below) is widely distributed there; 1 additional genus occurs in the Oriental Region; 2 more, in Madagascar.

Genus *HEXAGONIA* Kirby

Kirby 1825, Trans. Linnean Soc. London 14, p. 563.

Csiki 1932, Coleop. Cat., Carabidae, Harpalinae 7, p. 1506 (see for synonymy and additional references).

Jeannel 1948, Coléop. Carabiques de la Région Malgache, Part 2, p. 759.

Basilewsky 1948, Bull. Mus. Hist. Nat. Belgian Congo 24, p. 3 (African species).

Diagnosis. See under tribe, of which this is the only genus represented in New Guinea.

Description. None required here.

Type species. H. terminata Kirby, of SE. Asia.

Generic distribution. Tropical **Asia** and islands to **New Guinea** and northeastern **Australia**; **Africa**, **Madagascar**.

Notes. Members of this genus are rather diverse in the Oriental Region including the Philippines, but only 1 species group extends to New Guinea and Australia. Probably because they occupy an unusual niche and perhaps also because they are diurnal and may not fly to light, these insects are rarely collected. The 1 New Guinean and the 1 (undescribed) Australian species are each known from a single collection made by myself, by breaking down tall grass and other aquatic vegetation into water and picking up the beetles as they came to the surface.

Hexagonia papua n. sp.

Description. With characters of tribe; form as in Figure 124; head black; pronotum piceous, reddish at base and apex; elytra red in anterior ½ or more, black posteriorly, the black area extending farther forward on inner than on outer part of elytra; lower surface irregularly reddish and piceous; appendages brown; shining, reticulate microsculpture faint or absent on head and pronotum, imperfect on elytra; head and pronotum irregularly punctate. *Head* 1.05 and 1.05 width prothorax; front semicircularly impressed each side; neck deeply transversely impressed. *Prothorax* subcordate; width/length 1.06 and 1.09; base/apex not calculated (because prothorax rounded into neck without distinct anterior angles); margins narrow, each with seta *c.* ⅓ from apex, without posterior seta; disc with middle groove deeply impressed and subpunctate, other impressions irregular and weak. *Elytra*: width elytra/prothorax 1.66 and 1.67; striae well impressed, punctate; intervals slightly convex, 3rd with 3 or 4 conspicuous seta-bearing punctures, 5th with 1 such puncture *c.* ⅓ from apex on outer edge. *Lower surface*: head below transversely rugulose; prothorax below subrugosely punctate. *Inner wings* full. *Legs* moderate; tarsi wide; 4th tarsal segments very deeply emarginate, long-lobed; claws simple, not toothed. *Secondary sexual characters*: ♂ tarsi not or not much modified, without special squamules; ♂ with 2, ♀ 3 short setae near apex each side last ventral segment. *Measurements*: length 7.2–7.8; width 2.2–2.4 mm.

Types. Holotype ♂ (M.C.Z., Type No. 31,505) and 12 paratypes all from Aitape, **N-E. N. G.,** Aug. 1944 (Darlington).

Measured specimens. The ♂ holotype and 1 ♀ paratype (sexes of these specimens determined by dissection).

Notes. This new *Hexagonia* is probably related to *lucasseni* van der Poll of Java but is slightly more slender and much darker, with pronotum piceous (red in *lucasseni*) and elytra more extensively black posteriorly. One or more similar but apparently undescribed species occur in the Philippines.

The habitat of the species is noted under the genus.

Tribe ODACANTHINI

Sloane 1917, Proc. Linnean Soc. New South Wales 42, p. 413.
——— 1923, Proc. Linnean Soc. New South Wales 50, p. 30.
Jedlicka 1963, Ent. Abhandlungen 28, p. 488.
Habu 1967, Fauna Japonica, Carabidae, Truncatipennes Group, p. 13.
Odacanthidae Jeannel 1948, Coléop. Carabiques de la Région Malgache, Part 2, p. 745.
Odacanthinae Basilewsky 1953, Exploration Parc National l'Upemba, Fasc. 10, Carabidae, p. 108.
Colliurini Csiki 1932, Coleop. Cat., Carabidae, Harpalinae 7, p. 1517 (see for synonymy and additional references).
Liebke 1938, Festschrift Embrik Strand 4, pp. 37–141.

Most members of this tribe have a characteristic form (Figs. 125–131), with prothorax very long and narrow, usually much narrower than head. Technical characters of the tribe are given by authors cited above. The tribe is well represented in the tropics of both hemispheres, less well represented in most temperate regions, but several remarkable endemic genera occur in Australia.

Liebke (1938) has published a useful generic classification of this tribe for the world. His classification is, however, artificial, as shown by the failure of some of my new New Guinean species to fit into it. The form of the 4th hind-tarsal segments, used by Liebke in the first couplet of his key, is a particularly unsatisfactory generic character. Form of the 4th hind-tarsal segments does characterize some genera, but it is extremely variable in others. See, for example, *Notes* under *Dicraspeda* in the following pages. However, I cannot undertake to revise the generic classification in dealing with the few members of the tribe that occur in New Guinea, except in the case of primarily New Guinean genera.

Ecologically, Odacanthini are active, winged carabids some of which live in foliage and some on the ground. Of the New Guinean forms, *Dicraspeda* (including *Philemonia* and *Macrocentra*) lives in understory foliage of rain forest; *Clarencia* and some *Colliuris*, in or under low vegetation or dead leaves in wet places; *Casnoidea*, among reeds and in other vegetation in water; *Eudalia* (in Australia), *Dobodura*, and I think also *Lachnothorax*, in gravel and among stones by running water; and *Basisticus* (in Australia), on the ground in relatively dry places including open *Eucalyptus* woodland.

Eight genera, 19 species of Odacanthini, are known from New Guinea. Two or 3 stocks of *Colliuris*, 1 species of *Casnoidea*, and *Lachnothorax* have probably reached New Guinea rather recently from the Oriental Region. A second species of *Casnoidea* and also *Basisticus micans* (which may be related to *Colliuris*) are shared with Australia. *Clarencia* and *Eudalia* are shared with Australia and may be of Australian origin. Monotypic *Dobodura* is confined to New Guinea but may be derived from *Eudalia*. And *Dicraspeda* (*sensu lato*) has radiated chiefly in the rain forests of New Guinea, where 6 diverse species now exist.

Key to Genera of Odacanthini of New Guinea

1. Lateral margins of prothorax incomplete *and* 4th hind-tarsal segments very long-lobed; strikingly bicolored, black (or piceous) and red (p. 207) *Casnoidea*
– Not as above in one or more ways; usually not black-and-red bicolored (obscurely so in *Basisticus*) 2
2. Antennae with 3rd segments very long, *c.* ⅔ longer than 4th segments (p. 209) *Clarencia*
– Antennae with 3rd segments shorter, equal to or not more than ¼ longer than 4th segments 3
3. Head with fine costa each side above eye *and* pronotum channeled at sides and middle; (base of elytra not *coarsely* punctate-striate) (p. 210) *Dicraspeda*
– Not as above in one or more ways 4
4. Body pubescent (p. 214) *Lachnothorax*
– Not pubescent 5
5. Eyes not margined on inner edges by costae *and* front smooth 6
– Eyes usually margined by costae, or if (rarely) not margined, front so coarsely punctate that supraocular costae are indistinct 7
6. Elytra not spined (p. 214) *Eudalia*
– Elytra spined (see also *Notes* under this genus) (p. 215) *Dobodura*
7. Side margins of prothorax absent or incomplete *or* (if margins nearly complete) pronotum not channeled at middle; elytra not very differently sculptured at base and apex (p. 205) *Colliuris*
– Side margins of prothorax complete *and* pronotum channeled at middle; elytra coarsely punctate-striate in anterior ⅓, smooth posteriorly (p. 208) *Basisticus*

Genus COLLIURIS Degeer

Degeer 1774, Mém. Hist. Insectes 4, p. 79.
Csiki 1932, Coleop. Cat., Carabidae, Harpalinae 7, p. 1518 (see for synonymy and additional references).
Liebke 1938, Festschrift Embrik Strand 4, p. 45.
Jedlicka 1963, Ent. Abhandlungen 28, pp. 489, 490.

Diagnosis. See preceding *Key to Genera.*

Description. None required here.

Type species. Attelabus surinamensis Linnaeus, of South America.

Generic distribution. All warm regions of the **world**. In the Asiatic-Australian area, species are moderately numerous and diverse in southern **Asia** and the western **Malay Archipelago**, but only 4 species (representing 3 independent stocks) have been found in **New Guinea**. According to Liebke, the genus does not reach **Australia**, but I found 3 species of it (representing 2 of the same stocks that are in New Guinea) in North Queensland in 1958.

Notes. I cannot fit the New Guinean species into Liebke's subgenera satisfactorily. *C. rossi* (below) and also the Australian *C. obscura* Castelnau have virtually complete lateral prothoracic margins, which rules these species out of *Colliuris* entirely, according to Liebke (who in fact incorrectly put *obscura* in *Dicraspeda*). Nevertheless, in form and other characters these

species seem to me to be closely related to *Colliuris* subgenus *Eucolliuris* of Africa and the Oriental Region.

KEY TO SPECIES OF *COLLIURIS* OF NEW GUINEA

1. Prothorax with lateral margins; intervals 3, 5, 7 with seta-bearing punctures; (pronotum and elytral striae coarsely punctate, head smooth) (p. 205) ..... *rossi*
– Prothorax without lateral margins, or margins reduced to sutures; only 3rd intervals with seta-bearing punctures 2
2. Not maculate; subcylindric, elytra not more than 2× width prothorax; entire upper surface coarsely punctate (p. 205) ..... *fuscipennis*
– Quadrimaculate; broader, elytra more than 2× width prothorax; upper surface *c.* impunctate except for finely punctate elytral striae 3
3. Less slender, prothoracic width/length 0.60 and 0.63; elytra not or not much impressed (p. 206) ..... *papua*
– More slender, prothoracic width/length 0.46 and 0.46; elytra transversely impressed near base (see also *Description*) (p. 206) ..... *par*

Colliuris rossi n. sp.

Description. Form (Fig. 125) of *Colliuris* of Oriental *fuscipennis* group; black, legs brown with dark knees, antennae brown, paler at base; shining, without reticulate microsculpture. *Head* 1.13 width prothorax; right mandible with acute tooth on inner edge; a fine costa over each eye separated from eye by groove; anterior and posterior supraocular seta-bearing punctures present but no other setae posteriorly; front convex, slightly impressed at middle and anteriorly, impunctate; mentum with acute tooth; ligula broad, 2-setose; palpi slender, acuminate, not pubescent. *Prothorax* long-oval; width/length 0.71; base/apex 1.34; side margins entire except confused by punctation at extreme base, narrow, each with 1 seta before middle; middle line light; disc strongly convex, irregularly coarsely punctate. *Elytra* subparallel; width elytra/prothorax 2.00; apices obliquely sinuate-truncate with outer and sutural angles blunt; striae coarsely punctate, the punctures becoming finer posteriorly; intervals 3, 5, 7 each with 4 to 6 well spaced seta-bearing punctures. *Inner wings* full. *Lower surface* not pubescent, coarsely punctate anteriorly including sides of metasternum, smooth posteriorly. *Legs* normal; tarsi not pubescent and not sulcate above; 4th hind-tarsal segments shallowly emarginate. *Secondary sexual characters*: ♂ front tarsi narrow, 3 segments narrowly 2-seriately squamulose; ♂ last ventral segment *c.* semicircularly emarginate at apex, with 1 seta each side; ♂ copulatory organs as in Figure 179; ♀ unknown. *Measurements*: length *c.* 6.5; width 2.0 mm.

Type. Holotype ♂ (Cal. Acad.) from Finschhafen, **N-E. N. G.,** May 7, 1944 (E. S. Ross); the type is unique.

Notes. This new species seems closely allied only to *C. obscura* (Castelnau) of NE. Australia, but *obscura* has only the 3rd elytral intervals with seta-bearing punctures. Otherwise the two species agree in most characters including presence of virtually entire prothoracic margins, distribution of coarse punctation (head impunctate, pronotum contrastingly coarsely punctate), ♂ secondary sexual characters, and presence of an acute tooth on the right mandible in some individuals. However, presence of the mandibular tooth does seem to be an individual character in *obscura*: in my series from Cairns, the tooth is well developed in some and almost absent in other specimens.

The generic assignment of *obscura* and *rossi* is doubtful. Sloane (1923, Proc. Linnean Soc. New South Wales 48, p. 31) thought *obscura* might go in *Arame*, which is doubtful, and Liebke (1938, Festschrift Embrik Strand 4, p. 89) put it in *Dicraspeda*, which is certainly wrong. Only the presence of nearly entire prothoracic margins prevents placing both *obscura* and *rossi* in *Colliuris* in Liebke's classification, and I doubt if the prothoracic margins are of generic value in this case.

Colliuris fuscipennis (Chaudoir)

Chaudoir 1850, Bull. Soc. Nat. Moscow 23, Part 1, p. 26 (*Casnonia*).

Andrewes 1927, Ann. Mag. Nat. Hist. (9) 19, p. 106 (*Odacantha*).
Csiki 1932, Coleop. Cat., Carabidae, Harpalinae 7, p. 1527 (see for synonymy, "varieties," and additional references).
Liebke 1938, Festschrift Embrik Strand 4, p. 65, fig. 27.
Jedlicka 1963, Ent. Abhandlungen 28, p. 494, figs. 190–193.

Description. None required here. Note form rather slender; color black with apex of elytra reddish, legs testaceous; upper surface including head coarsely punctate; length *c.* 5½ mm.

Type. From **China** ("Chine, Tchusan?"); in Oberthür Coll., Paris Mus. (not seen).

Occurrence in New Guinea. **Papua**: 1, Lake Daviumbu, Fly R., Aug. 19–30, 1936 (Archbold Exp., A.M.N.H.).

Notes. Fuscipennis is the oldest name for a very common species or group of closely related species previously known from **SE. Asia** to **Celebes** and the **Philippines**. Andrewes (1927) says of it that *fuscipennis* Chaudoir, *punctata* Nietner, *haemorrhoidalis* Motschulsky, and *flavicauda* Bates "appear to differ very little from each other; they may all prove to belong to the same species, but at present I have not the means of deciding this." Csiki's, Liebke's, and Jedlicka's treatment of some of the doubtful forms as subspecies or varieties is not acceptable. Under these circumstances I can only refer the New Guinean individual to *fuscipennis sensu lato*, pending revision of all related forms.

Colliuris papua n. sp.

Description. With characters of genus; form (Fig. 126) of *Colliuris*, with moderately broad elytra scarcely impressed before middle; black, each elytron with 2 *c.* round yellow spots, centered on 4th and 5th intervals, before middle and before apex; appendages brown, antennae paler at base; moderately shining, reticulate microsculpture faint and *c.* isodiametric on front, transverse on head posteriorly and on pronotum, indistinct on elytra. *Head* 1.44 and 1.41 width prothorax; 2 setae over each eye but no other setae posteriorly; front scarcely impressed, impunctate. *Prothorax* long, swollen at sides behind middle, strongly narrowed anteriorly; width/length 0.60 and 0.63; base/apex 1.54 and 1.56; lateral margins reduced to sutures, each with 1 seta before middle; disc strongly convex, base scarcely impressed, middle line fine, surface faintly transversely strigulose, punctate across base. *Elytra*: width elytra/prothorax 2.24 and 2.22; apices obliquely truncate (slightly emarginate) with outer angles rounded, sutural angles scarcely blunted; striae formed by rows of small punctures which become minute posteriorly; 3rd intervals with *c.* 4 seta-bearing punctures, intervals 5 and 7 without punctures. *Inner wings* full. *Lower surface* punctate only around front coxae and at front of mesosternum. *Legs* normal; tarsi not pubescent and not sulcate above; 4th hind-tarsal segments shallowly emarginate. *Secondary sexual characters*: ♂ front tarsi narrow, narrowly 2-seriately squamulose below; last ventral segment slightly emarginate at apex in ♂, variably impressed in ♀, with 1 seta each side in ♂, 2 in ♀. *Measurements*: length *c.* 5.5–6.0; width 1.6–1.8 mm.

Types. Holotype ♂ (M.C.Z., Type No. 31,506) and 35 paratypes all from Dobodura, **Papua**, Mar.–July 1944 (Darlington).

Measured specimens. The ♂ holotype and 1 ♀ paratype.

Notes. See *Notes* under the following species, *par.*

Colliuris par n. sp.

Description. Similar in form and most characters to preceding (*papua*) but more slender, with elytra impressed before middle; anterior elytral spots longer and almost confined to 5th intervals, legs pale at base; reticulate microsculpture not distinct on pronotum. *Head* 1.65 and 1.58 width prothorax. *Prothorax*: width/length 0.46 and 0.46; base/apex 1.55 and 1.56; disc transversely impressed and constricted before base. *Elytra*: width elytra/prothorax 2.60 and 2.62. *Lower surface* as in *papua* except

with row of coarse punctures each side prosternum before coxae. *Secondary sexual characters*: as for *papua*. *Measurements*: length *c.* 6.0–7.0; width 1.7–2.0 mm.

Types. Holotype ♂ (M.C.Z., Type No. 31,507) and 5 paratypes all from Hollandia, **West N. G.,** July–Sept. 1944 (Darlington).

Additional material. **N-E. N. G.**: 7, Aitape, Aug. 1944 (Darlington).

Measured specimens. The ♂ holotype and 1 ♀ paratype.

Notes. C. papua and *par* seem to be allopatric representatives of one ancestral stock, but they differ too much to be considered subspecies. *C. par* is the more widely distributed: I found it at Cape Gloucester, **New Britain**, in 1944, and (1 ♀) at Lockerbie, near the tip of Cape York, Queensland, **Australia**, in 1958. A second ♀ from Lockerbie is superficially similar but much more compact and differs in other details. I think it probably represents a 3rd, distinct species of this group of *Colliuris*.

Genus *CASNOIDEA* Castelnau

Castelnau 1834, Études Ent. 1, p. 40.
Csiki 1932, Coleop. Cat., Carabidae, Harpalinae 7, p. 1534 (see for synonymy, additional references, and list of species).
Jedlicka 1963, Ent. Abhandlungen 28, pp. 489, 498.
Ophionea Eschscholtz 1829, Zool. Atlas 2, p. 5 (not *Ophionea* Klug 1821).
Liebke 1938, Festschrift Embrik Strand 4, p. 79.

Diagnosis. See preceding *Key to Genera*.

Description. None required here.

Type species. Of both *Casnoidea* and *Ophionea* Eschscholtz, *Attelabus indica* Thunberg.

Generic distribution. **SE. Asia** including **Ceylon** and **Japan** to **Australia**; a species recorded also from the **Seychelles Is.**

Notes. This genus of slender, usually strikingly bicolored (red and black) carabids includes several species widely distributed in SE. Asia and the Malay Archipelago. They are usually found in grass, reeds, and other vegetation growing in water.

KEY TO SPECIES OF *CASNOIDEA* OF NEW GUINEA

1. Color dark with basal ⅓ or ⅔ of elytra red (p. 207) ..... *gestroi*
– Color red with head, post-median elytral fascia, and sometimes bases of elytra dark (the post-median fascia with a pale spot on each elytron) 2
2. Pronotum conspicuously punctate (p. 207) ..... *puncticollis*
– Pronotum not conspicuously punctate 3
3. Elytra not dark at base (p. 208) ..... (*nigrofasciata*)
– Elytra dark at base (p. 208) ..... (*indica*)

Casnoidea gestroi (Maindron)

Maindron 1910, Bull. Soc. Ent. France for 1910, p. 34 (*Ophionea*).
Dupuis 1913, Ann. Soc. Ent. Belgium 57, p. 270.
Liebke 1938, Festschrift Embrik Strand 4, p. 79, fig. 60 (*Ophionea*).
gestronis Seidlitz 1912, Archiv für Naturgeschichte 77, Part 3, p. 155 (error for *gestroi*).

Description. None required here; see preceding *Key to Species*; length *c.* 7.0–7.5 mm.

Type. From Dilo, **Papua**, July 1890 (D. Loria); presumably in Paris Mus. (not seen).

Occurrence in New Guinea. **Papua**: 7, Dobodura, Mar.–July 1944 (Darlington); 2, Kiunga, Fly R., July 15–21, Aug. 1–3, 1957 (W. W. Brandt, Bishop Mus.). **West N. G.**: 1, Waris, S. of Hollandia, 450–500 m, Aug. 8–15, 1959 (T. C. Maa, Bishop Mus.); 1, Wasian, Vogelkop, Sept. 1939 (Wind, M.C.Z.).

Notes. This distinct species is evidently widely distributed in New Guinea and is represented also on **New Britain** (an undescribed subspecies from Cape Gloucester) but is unknown elsewhere.

Casnoidea puncticollis (Sloane)

Sloane 1923, Proc. Linnean Soc. New South Wales 48, p. 31 (*Ophionea*).
Liebke 1938, Festschrift Embrik Strand 4, p. 80 (*Ophionea*).

Description (for recognition only). Form as in Figure 127; red, head black, elytra with broad transverse fascia (bluish) black, the fascia with an elongate pale fleck on each 5th interval, legs bicolored; shining,

without reticulate microsculpture. *Head* short, rounded posteriorly; front wrinkled anteriorly, impunctate. *Prothorax* long-oval; side margins irregularly indicated anteriorly; disc conspicuously punctate. *Elytra* punctate-striate. *Measurements* (New Guinean specimen): length *c.* 7.5; width 2.1 mm.

Type. From Burdekin R., Queensland, **Australia**; in Sloane Coll., C.S.I.R.O., Canberra (seen).

Occurrence in New Guinea. **Papua**: 1, Kiunga, Fly R., Aug. 1–3, 1957 (W. W. Brandt, Bishop Mus.).

Notes. I do not have *puncticollis* from Australia and have identified the New Guinean individual from description. Note that *C. gestroi* (preceding species) as well as *puncticollis* occurred at Kiunga.

(*Casnoidea nigrofasciata* (Schmidt-Goebel))

Schmidt-Goebel 1846, Faunula Coleop. Birmaniae, p. 21 (*Ophionea*).
Andrewes 1930, Treubia 7, Supplement, p. 334 (*Ophionea*).
Csiki 1932, Coleop. Cat., Carabidae, Harpalinae 7, p. 1535 (see for synonymy and additional references).
Liebke 1938, Festschrift Embrik Strand 4, p. 80, fig. 57 (*Ophionea*).

Description. None required here; see preceding *Key to Species.*

Type. From **Burma**; in Prague Mus. (not seen).

Occurrence in New Guinea. Probably does not occur.

Notes. C. nigrofasciata ranges from **SE. Asia** to **Java** and **Borneo**. It is apparently not recorded from Celebes or the Moluccas. New Guinea is included in the species' range by Csiki, but I can find no authority for this. I suspect that a too-hasty compiler, not noticing the negative, picked "New Guinea" out of Andrewes' (1930) statement that "I have seen no examples either from Japan or New Guinea."

(*Casnoidea indica* (Thunberg))

Thunberg 1784, Novas Insectorum Species 3, p. 68, fig. 81 (*Attelabus*).
Andrewes 1930, Cat. Indian Insects, Part 18, Carabidae, p. 241 (*Ophionea*).
Csiki 1932, Coleop. Cat., Carabidae, Harpalinae 7, p. 1534 (see for synonymy and additional references).
Liebke 1938, Festschrift Embrik Strand 4, p. 79, fig. 55 (*Ophionea*).
Louwerens 1958, Treubia 24, p. 249 (Moluccas) (*Ophionea*).

Description. None required here; see preceding *Key to Species.*

Type. From "**India orientali**"; presumed lost (not seen).

Occurrence in New Guinea. Doubtful.

Notes. This common Oriental carabid ranges from **SE. Asia** including **Ceylon** and **Japan** to **Celebes** and the **Moluccas**. A specimen in the British Museum is labeled "Dory, New Guinea" but may be from Celebes or the Moluccas (see Part I of my "Carabid Beetles of New Guinea," p. 331). Other collectors have failed to find the species in New Guinea. Andrewes' statement that *indica* occurs south to New Guinea is probably based on the doubtful "Dory" specimen.

Genus *BASISTICUS* Sloane

Sloane 1917, Proc. Linnean Soc. New South Wales 42, p. 415.
——— 1923, Proc. Linnean Soc. New South Wales 48, p. 30.
Liebke 1938, Festschrift Embrik Strand 4, p. 81.

Diagnosis. See preceding *Key to Genera.*

Description. None required here.

Type species. Odacantha micans Macleay (below).

Generic distribution. As of the single known species.

Notes. This genus is close to *Colliuris* (*sensu lato*), from which it differs in having the lateral margins of the prothorax entire.

Basisticus micans (Macleay)

Macleay 1864, Trans. Ent. Soc. New South Wales 1, p. 107 (*Odacantha*).
Csiki 1932, Coleop. Cat., Carabidae, Harpalinae 7, p. 1535 (see for additional references).
Liebke 1938, Festschrift Embrik Strand 4, p. 81.

Description (for recognition only). Form

of *Colliuris*; head and prothorax red, base of elytra dark reddish, smooth part of elytra piceous, antennae red, legs dark with pale bases; elytra very coarsely punctate-striate in anterior ⅓, smooth with striae of minute punctules in posterior ⅔; length *c.* 6.5 mm.

Type. From Port Denison, northern **Australia** (presumably near Bowen, Queensland); probably in Macleay Mus., Sydney (not seen).

Occurrence in New Guinea. **Papua**: 1, Rouku, Morehead R., March 1962 (W. W. Brandt, C.S.I.R.O.).

Notes. This is an Australian species, well known in North Queensland. I have specimens from the vicinity of Cairns, Mareeba, and Townsville. The single individual from New Guinea matches Australian ones well. In Australia, this insect is found on the ground in open woodland; the type was "found under dried cow dung."

Genus *CLARENCIA* Sloane

Sloane 1917, Proc. Linnean Soc. New South Wales 42, p. 415.
——— 1923, Proc. Linnean Soc. New South Wales 48, p. 30.
Csiki 1932, Coleop. Cat., Carabidae, Harpalinae 7, p. 1535.
Liebke 1938, Festschrift Embrik Strand 4, p. 81.

Diagnosis. See preceding *Key to Genera*; note form of large *Colliuris*; antennae with very long 3rd segments (and see *Notes*, below); ♂ front tarsi with 3 segments with numerous narrow squamae loosely arranged (not 2-seriate as in *Colliuris*); last ventral segment slightly emarginate at apex in both sexes, with 1 seta each side in ♂, 2 in ♀.

Description. None required here.

Type species. Casnonia aliena Pascoe, of Australia.

Generic distribution. Eastern **Australia**, **New Guinea**.

Notes. Although only 1 *Clarencia* is currently recognized (Csiki, 1932), 4 species are represented in Australian material collected by me in 1957–1958. One of these species (described below as *quadridens*) occurs also in New Guinea, and 1 additional species of the genus is endemic in New Guinea.

The antennae of some Australian *Clarencia* not only have very long 3rd segments but also have the 4th segments uniquely modified: expanded and obliquely truncate at apex so that the 5th segments hinge forward, and with the pubescence of the 4th segments restricted to the segments' anterior edges. This modification of the 4th segments is only slightly indicated in the New Guinean species, more clearly in *papua* than in *quadridens*.

The species of *Clarencia* are usually found in wet places, often by standing water, either among wet leaves or in or under low vegetation.

KEY TO SPECIES OF *CLARENCIA* OF NEW GUINEA

1. Elytra toothed at sutural and outer-apical angles (p. 209) . . . . . *quadridens*
– Elytra not toothed (p. 210) . . . . . *papua*

Clarencia quadridens n. sp.

Description. With characters of genus; form as in Figure 128, with elytra transversely impressed near base; black, elytra ± yellowish at apex but not spotted, epipleuri pale, femora pale at base, dark at apex, tibiae dark banded with pale, tarsi pale, antennae brown darker basally; shining, without distinct reticulate microsculpture. *Head* 1.37 and 1.27 width prothorax; front with conspicuous V-shaped impression anteriorly, impunctate. *Prothorax* long, with sides swollen behind middle; width/length 0.59 and 0.61; base/apex 1.38 and 1.40; disc very convex, with fine middle line, punctate across base with a few punctures along lateral margins and across apex but otherwise impunctate. *Elytra*: width elytra/prothorax 2.30 and 2.47; apices obliquely sinuate-truncate with outer and sutural angles acutely dentate; striae formed by lines of punctures anteriorly, obsolete posteriorly; 3rd intervals with *c.* 6 and 5th intervals with *c.* 4 seta-bearing punctures. *Legs* slender; tarsi above not pubescent and not sulcate; 4th hind-tarsal seg-

ments shallowly emarginate. *Measurements*: length 10.0–11.5; width 2.8–3.1 mm.

Types. Holotype ♂ (M.C.Z., Type No. 31,508) and 14 paratypes from Hollandia, **West N. G.,** July–Sept. 1944 (Darlington); and additional paratypes from **West N. G.** as follows: 4, Hollandia, Apr., May 1945 (B. Malkin, U.S.N.M.); 2, "Neth. N. G." without further locality (T. Aarons, Cal. Acad.).

Additional material. **West N. G.**: 1 teneral ♂, Maffin Bay, Aug. 1944 (Darlington). **Papua**: 1 ♂, Normanby Is., Wakaiuna, Sewa Bay, Jan. 1–8, 1957 (W. W. Brandt, Bishop Mus.).

Measured specimens. The ♂ holotype and 1 ♀ paratype from Hollandia.

Notes. The denticulate elytra distinguish this species from all other known *Clarencia* in Australia as well as New Guinea. This species occurs in **Australia**: I have one ♀ from near Cairns, N. Queensland (Darlington). This Australian specimen and the one from Normanby Is. have more yellow at apex of elytra than Hollandia specimens do.

Clarencia papua n. sp.

Description. With characters of genus; form *c.* as in *quadridens* (above) except elytra relatively narrower and not dentate; black, elytra scarcely paler at apex, legs bicolored as in *quadridens*, antennae brown; shining, without distinct reticulate microsculpture. *Head* 1.32 and 1.22 width prothorax; front convex except impressed anteriorly as in *quadridens*, impunctate. *Prothorax* formed as in *quadridens* but slightly shorter; width/length 0.62 and 0.68; base/apex 1.37 and 1.41; disc very convex, middle line fine, surface closely wrinkled-punctate across base, variably punctate across apex, and more extensively punctate at sides than in *quadridens*. *Elytra*: width elytra/prothorax 2.21 and 2.10; apices obliquely sinuate-truncate with outer and sutural angles narrowly rounded; striae nearly entire (longer than in *quadridens*), punctate, the punctures becoming minute posteriorly; 3rd and 5th intervals with a few seta-bearing punctures. *Legs c.* as in *quadridens*. *Measurements*: length *c.* 9.0–10.0; width 2.5–2.9 mm.

Types. Holotype ♂ (U.S.N.M.) and 7 paratypes (some in M.C.Z., Type No. 31,509) from Hollandia, **West N. G.,** Apr., May, June (holotype, Apr.) 1945 (B. Malkin); 1 paratype, same locality, "11/5/44" (W. T. Nailon, Fenton Coll.); 1 paratype, Yentchan, Main R., Sepik, **N-E. N. G.,** Feb. 1965 (R. Hornabrook).

Additional material. **Papua**: 2, Lake Daviumbu, Fly R., Aug. 19–30, Sept. 11–20, 1936 (Archbold Exp., A.M.N.H.).

Measured specimens. The ♂ holotype and 1 ♀ paratype.

Notes. See preceding *Description* for details distinguishing *papua* from *quadridens*. Actually, *papua* may be more closely related to undescribed Australian species.

Genus *DICRASPEDA* Chaudoir

Chaudoir 1862, Bull. Soc. Nat. Moscow 35, Part 2, p. 300.

Csiki 1932, Coleop. Cat., Carabidae, Harpalinae 7, p. 1536 (see for partial synonymy and additional references).

Liebke 1938, Festschrift Embrik Strand 4, pp. 43, 88.

Macrocentra Chaudoir 1869, Revue et Magasin Zool. (2) 21, p. 205 (new synonymy).

Liebke 1938, Festschrift Embrik Strand 4, pp. 39, 100.

Loxocara Sloane 1907, Deutsche Ent. Zeitschrift for 1907, pp. 179, 474.

Philemonia Liebke 1938, Festschrift Embrik Strand 4, pp. 39, 83 (new synonymy).

Diagnosis. Form as in Figure 129 but somewhat variable, color black or metallic, not maculate. *Head*: a fine costa over each eye; antennae with 3rd segments not or not much longer than 4th segments. *Prothorax* moderately long; pronotum channeled at sides and with deep median groove. *Elytra*: apices variable (see following *Key to Species*). *Legs*: tarsi not pubescent above (Liebke's statement that tarsi of *Macrocentra* are pubescent above is erroneous); 4th hind-tarsal segments variably emarginate or lobed (see *Notes*,

below). *Secondary sexual characters*: ♂ front tarsi narrow, narrowly 2-seriately squamulose; ♂ with 1, ♀ 2 setae each side last ventral segment.

Description. None required here.

Type species. Of *Dicraspeda, D. brunnea* Chaudoir (see below). Of *Macrocentra, M. quadrispinosa* Chaudoir, of New Guinea. Of *Loxocara, L. quadrispinosa* Sloane (= *M. quadrispinosa* Chaudoir). Of *Philemonia, P. longiloba* Liebke, of New Guinea.

Generic distribution. Most diverse in **New Guinea**; several New Guinean species reach **New Britain**, etc.; species of *Dicraspeda sensu stricto* (small forms with unarmed elytra) occur in **Australia**, and 1 (*brunnea* Chaudoir, below) extends to **Timor**, **Java**, and the **Philippines**.

Notes. The 6 New Guinean species here brought together in *Dicraspeda* are superficially diverse, differing in form, presence or absence of elytral spines, and form of 4th hind-tarsal segments. But the differences are all gradational (see following paragraphs), different characters vary independently, and the 6 species all share characters given in the preceding *Diagnosis*. Moreover, they all inhabit understory foliage of rain forest, and I think that they are all probably derived from one ancestral stock that has diversified in this habitat. Five of the species are lowland forms and are sympatric, occurring together at Dobodura. The sixth species, *D.* ("*Macrocentra*") *violacea* (Sloane), occurs at moderate altitudes in the mountains.

The elytral apices are obliquely truncate with sutural angles usually slightly blunted and outer angles obtuse in *D.* (*sensu stricto*) *brunnea*. In the 3 species of "*Philemonia*," the sutural angles are either slightly blunted (most individuals of *longiloba*), variably denticulate (*dubia* and some individuals of other species), or spined (typical individuals of *bispinosa*); the outer-apical angles are well formed in these species and usually acute in *longiloba*, but not spined. And in the 2 species of "*Macrocentra*" (*quadrispinosa* and *violacea*), outer-apical as well as sutural angles are spined.

Variation of the 4th hind-tarsal segments is noteworthy and is not correlated with the insects' size or with form of elytral apices. The 4th hind-tarsal segments are shallowly emarginate (Fig. 163) in *D.* (*sensu stricto*) *brunnea*; very deeply emarginate with extremely long lobes (Fig. 165) in *D.* ("*Philemonia*") *longiloba*, which resembles *brunnea* in size and elytral apices; and intermediate but variable in the other species (other "*Philemonia*" and "*Macrocentra*").

Key to Species of *Dicraspeda* of New Guinea

1. Elytra without spines or with spines only at sutural angles 2
– Elytra with spines at sutural and outer-apical angles 5
2. Fourth hind-tarsal segments emarginate for *c.* ⅓ segments' length; elytra with sutural angles slightly blunted, outer-apical angles obtuse; length *c.* 5.5–6.0 mm (p. 211) ... *brunnea*
– Fourth hind-tarsal segments more deeply emarginate; elytra with sutural angles denticulate or spined (except in most *longiloba*); size larger 3
3. Fourth hind-tarsal segments very long-lobed (Fig. 165); sutural angles usually blunted; length *c.* 6.5–7.5 mm (p. 212) ... *longiloba*
– Fourth hind-tarsal segments with shorter lobes; sutural angles denticulate or spined; size usually larger 4
4. Fourth hind-tarsal segments with lobes *c.* ½ segments' length; sutural angles denticulate; length 6.5–8.0 mm (p. 212) ..... *dubia*
– Fourth hind-tarsal segments with longer lobes; sutural angles spined or denticulate; length 8.0–9.5 mm (p. 212) ..... *bispinosa*
5. Color black; tarsi sulcate-carinate above; length *c.* 11–13 mm (p. 213) ..... *quadrispinosa*
– Color green-purple; tarsi not sulcate-carinate above; length *c.* 11–12 mm (p. 213) ..... *violacea*

Dicraspeda brunnea Chaudoir

Chaudoir 1862, Bull. Soc. Nat. Moscow 35, Part 2, p. 300.

Csiki 1932, Coleop. Cat., Carabidae, Harpalinae 7, p. 1536 (see for synonymy and additional references).

Liebke 1938, Festschrift Embrik Strand 4, p. 89.

Description. None required here; note

size small; pronotum punctate across base and apex and in lateral and median grooves but widely smooth at middle; elytral apices unarmed; 4th hind-tarsal segments not deeply emarginate (Fig. 163); length *c.* 5.5–6.0 mm.

Type. From **Celebes**; in Oberthür Coll., Paris Mus. (not seen).

Occurrence in New Guinea. **Papua**: 9, Dobodura, Mar.–July 1944 (Darlington); 1, Normanby Is., Wakaiuna, Sewa Bay, Jan. 1–8, 1957 (W. W. Brandt, Bishop Mus.). **N-E. N. G.**: 1, Wareo, Finschhafen (Rev. L. Wagner, S. Australian Mus.). **West N. G.**: 3, Hollandia and vicinity (various dates and collectors).

Notes. *D. brunnea* is recorded from **Australia** (Queensland), **Timor**, **Celebes**, **Java**, and **Mindanao**, and I have specimens from **Leyte** and **Luzon** and **New Britain** as well as from **New Guinea**.

Dicraspeda longiloba (Liebke)

Liebke 1938, Festschrift Embrik Strand 4, p. 83 (*Philemonia*).

Description. None required here; note elytra with sutural angles blunt or at most minutely denticulate; 4th hind-tarsal segments very long-lobed (Fig. 165); length *c.* 6.5–7.5 mm.

Type. From **N-E. N. G.** ("Deutsch-Neu-Guinea"); in Liebke Coll., present location unknown (not seen).

Occurrence in New Guinea. **N-E. N. G.**: the type. **Papua**: 5, Dobodura, Mar.–July 1944 (Darlington).

Notes. I have a specimen also from Cape Gloucester, **New Britain**.

Dicraspeda dubia (Gestro)

Gestro 1879, Ann. Mus. Civ. Genoa 14, p. 558 (*Odacantha*).
Liebke 1938, Festschrift Embrik Strand 4, p. 83, fig. 67 (*Philemonia*).

Description. None required here; note elytra with sutural angles variably denticulate but not spined; 4th hind-tarsal segments rather short-lobed but somewhat variable; length *c.* 6.5–8.0 mm.

Type. From Fly R., presumably Papua; in Genoa Mus. (not seen).

Occurrence in New Guinea. **Papua**: 3, Dobodura, Mar.–July 1944 (Darlington); 5, Kokoda, 1200, 1300 ft., May, Aug., Sept., Oct. 1933 (Cheesman). **N-E. N. G.**: 1, Aitape, Aug. 1944 (Darlington); 1, Wau, Morobe Dist., 1200 m, Aug. 18, 1961 (Sedlacek), in light trap. **West N. G.**: 1, Waris, S. of Hollandia, 450–500 m, Aug. 16–23, 1959 (T. C. Maa, Bishop Mus.); 1, Nabire, S. Geelvink Bay, 0–30 m, July 2–9, 1962 (Gressitt); 1, Waigeu Is., Camp 1, Mt. Nok, 2500 ft. (*c.* 760 m), May 1938 (Cheesman).

Notes. I found this or a closely related species also at Bamaga, near the tip of Cape York, **Australia**.

Dicraspeda bispinosa n. sp.

Description. With characters of genus; form as in Figure 129; brownish black, legs dark, antennae and mouthparts paler brown; moderately shining, reticulate microsculpture indistinct on head and pronotum, isodiametric or slightly transverse on elytra. *Head* 1.17 and 1.17 width prothorax; front irregularly impressed anteriorly, impunctate; mentum with long narrow tooth; ligula 4-setose. *Prothorax* elongate-subquadrate with sides swollen below margins; width/length 0.99 and 0.98; base/apex 1.19 and 1.12; pronotum strongly convex, narrowly channeled each side near margin and with well impressed middle groove; surface punctate chiefly across base, slightly at apex. *Elytra*: width elytra/prothorax 2.08 and 2.05; apices obliquely sinuate-truncate with sutural angles spined or denticulate, outer-apical angles obtuse, and apical margin in part minutely denticulate; striae entire, punctate; 3rd intervals 3-punctate, the posterior puncture near apex. *Inner wings* full. *Legs* normal; tarsi not sulcate and not pubescent above; 4th hind-tarsal segments long-lobed (Fig. 164). *Secondary sexual characters* as of genus; last ventral segment with small notch at apex in both sexes. *Measurements*: length

(including spines) *c.* 8.0–9.5; width 2.8–3.3 mm.

Types. Holotype ♀ (M.C.Z., Type No. 31,510) and 15 paratypes from Dobodura, **Papua**, Mar.–July 1944 (Darlington); and additional paratypes as follows. **Papua**: 2, Kokoda (Cheesman); 2, Mt. Lamington, 1300–1500 ft. (*c.* 400–460 m) (C. T. McNamara, S. Australian Mus.). **N-E. N. G.**: 4, Wau, Morobe Dist., 1150, 1200, 1300 m, dates in Jan., Feb., Oct., 1961, 1963 (Sedlacek); 1, Finschhafen, Huon Pen., 80–200 m, Apr. 13, 1963 (Sedlacek).

Additional material. **N-E. N. G.**: 4, Finschhafen, 80 m, Apr. 16, 1963 (Sedlacek); 1, same locality, 80–200 m, Apr. 13, 1963 (Sedlacek); 3, Pindiu, Huon Pen., dates in Apr. 1963 (Sedlacek).

Measured specimens. The ♂ paratype and ♀ holotype from Dobodura.

Notes. This new species would go in *Philemonia* in Liebke's classification. The specimens listed under *Additional material* have the sutural angles of the elytra denticulate rather than spined, but I think they are referable to *bispinosa*. Note that both spined and denticulate forms have been found at Finschhafen.

Dicraspeda quadrispinosa (Chaudoir)

Chaudoir 1869, Revue et Magasin Zool. (2) 21, p. 206 (*Macrocentra*).
Sloane 1907, Deutsche Ent. Zeitschrift for 1907, p. 474 (*Macrocentra*).
Liebke 1938, Festschrift Embrik Strand 4, p. 100 (*Macrocentra*).
Louwerens 1956, Treubia 23, p. 223 (Moluccas) (*Macrocentra*).
Loxocara quadrispinosa Sloane 1907, Deutsche Ent. Zeitschrift for 1907, p. 180.

Description. None required here; known among New Guinean Colliurini by size large; color plain black; elytra spined at sutural and outer-apical angles; tarsi sulcate-carinate above; length (including spines) *c.* 11–13 mm (rarely slightly smaller or larger).

Types. Of *quadrispinosa* Chaudoir, from Dorey, **West N. G.** (Wallace); in Oberthür Coll., Paris Mus. Of *quadrispinosa* Sloane, from Simbang, **N-E. N. G.**; "returned to Dr. Horn (for Bennigsen's collection)" (not seen).

Occurrence in New Guinea. Common: 227 specimens from localities on **New Guinea** and Normanby, Ferguson, Woodlark, Rossel, Sudest, and Waigeu Is.; apparently confined to low altitudes, up to 700, 750, 800, and 975 m at different localities, but none found higher; common at Dobodura.

Notes. This characteristic New Guinean carabid has been found also in the **Moluccas**, **New Britain**, and the **Solomons**, but not Australia.

Dicraspeda violacea (Sloane)

Sloane 1907, Deutsche Ent. Zeitschrift for 1907, pp. 181, 474 (*Macrocentra*).
Liebke 1938, Festschrift Embrik Strand 4, p. 100 (*Macrocentra*).
habilis Sloane 1907, Deutsche Ent. Zeitschrift for 1907, p. 181 (name used in error for *violacea*).

Description. None required here; similar to preceding (*quadrispinosa*) but head and pronotum greenish or bluish, elytra purple; tarsi not sulcate-carinate above; length *c.* 11–12 mm.

Type. From Sattelberg, **N-E. N. G.**; "returned to Dr. Horn (for Bennigsen's collection)" (not seen).

Occurrence in New Guinea. **N-E. N. G.**: 8, Wau, Morobe Dist., 1200, 1300 m, Jan., Mar., Apr., June, Sept., Nov., 1961–1963 (Sedlaceks); 1, Eliptamin Vy., 1665–2530 m, June 23–30, 1959 (W. W. Brandt, Bishop Mus.); 1, Finisterre Rge., Saidor, Kiambavi Village, July 22–29, 1958 (W. W. Brandt, Bishop Mus.); 1, Wareo, Finschhafen (Rev. L. Wagner, S. Australian Mus.); 1, Goroka, E. Highlands, 5200 ft. (*c.* 1600 m), J. H. Barrett, Dept. Agr. Port Moresby). **West N. G.**: 3, Rattan Camp, Snow Mts., 1150, 1200 m, Feb.–Mar. 1939 (Toxopeus); 5, Fac Fac, Vogelkop, 100–700 m, June 9, 1959 (Gressitt and T. C. Maa, Bishop Mus.), in light trap; 1, Mt. Baduri, Japen Is., 1000 ft., Aug. 1938 (Cheesman).

Notes. D. violacea apparently replaces *quadrispinosa* above 1000 m altitude in

New Guinea, but the two species overlap below 1000 m. *D. violacea* occurs also in **New Britain** (Gaulim, Gazelle Pen., 130 m, Nov. 28, 1962, Sedlacek).

Genus *LACHNOTHORAX* Motschulsky

Motschulsky 1862, Étude Ent. 11, p. 48.
Csiki 1932, Coleop. Cat., Carabidae, Harpalinae 7, p. 1542 (see for additional references).
Liebke 1938, Festschrift Embrik Strand 4, p. 103.
Jeannel 1948, Coléop. Carabiques de la Région Malgache, Part 2, p. 756.

Diagnosis. See *Key to Genera of Colliurini of New Guinea*; this is the only conspicuously pubescent colliurine in New Guinea.

Description. None required here.

Type species. L. biguttatus Motschulsky, of India.

Generic distribution. **Africa** and **Madagascar**; **SE. Asia** to **New Guinea**.

Notes. The few species of *Lachnothorax* are all very much alike. They are probably ground-living, and I suspect that they occur by running water.

Lachnothorax tokkia Gestro

Gestro 1875, Ann. Mus. Civ. Genoa 7, p. 856.
Csiki 1932, Coleop. Cat., Carabidae, Harpalinae 7, p. 1542 (see for synonymy and additional references).
Liebke 1938, Festschrift Embrik Strand 4, p. 104.
Jedlicka 1963, Ent. Abhandlungen 28, p. 504.

Description. None required here; note form, color black with pale spot before apex each elytron, and conspicuous pubescence; length *c.* 5.0–5.5 mm.

Type. From Kandari, SE. **Celebes**; in Genoa Mus. (not seen).

Occurrence in New Guinea. **N-E. N. G.**: 7, Stephansort, Astrolabe Bay, 1900 (Biró).

Notes. Lachnothorax tokkia has been recorded previously from the **Malay Pen.**, **Sumatra**, **Java**, and **Celebes**, and a very closely related species (*biguttata* Motschulsky) occurs in India and Ceylon.

Genus *EUDALIA* Castelnau

Castelnau 1867, Notes on Australian Coleop., p. 16.
Sloane 1917, Proc. Linnean Soc. New South Wales 42, pp. 415, 417–422 (with key to Australian species).
Csiki 1932, Coleop. Cat., Carabidae, Harpalinae 7, p. 1542 (see for synonymy and additional references).
Liebke 1938, Festschrift Embrik Strand 4, pp. 44, 105.

Diagnosis. See *Key to Genera.*

Description. None required here.

Type species. Odacantha latipennis Macleay, of Australia.

Generic distribution. **Australia** (*c.* 6 species) and **New Guinea** (1 species, doubtfully assigned to this genus).

Notes. The species described below as *Eudalia anomala* has entire lateral prothoracic margins and therefore runs to *Eudalia* in Liebke's key, but if the margins were obsolete, it would run to *Andrewesia*, to which it may be more closely related. (*Andrewesia obesa* (Andrewes) ranges from the Malay Pen. to the Moluccas.) Generic characters and limits in this group (as in so many others!) need revision.

Eudalia anomala n. sp.

Description. Form as in Figure 130; black, elytra faintly aeneous and tipped with yellow, legs testaceous, antennae brown paler at base; head and pronotum shining and without reticulate microsculpture, elytra duller with isodiametric meshes. *Head* 1.18 and 1.17 width prothorax; strongly constricted at neck; antennae with segments 3 and 4 subequal, pubescent from 4th segments; mandibles moderate in length and curvature; front convex, irregularly impressed anteriorly, impunctate; mentum with moderate tooth; ligula broad, with 2 long and 2 shorter setae; palpi slender, not pubescent. *Prothorax* suborbicular except parallel at base; width/length 0.89 and 0.90; base/apex 1.25 and 1.26 (sides of prothorax curve into condyle of neck at apex); lateral margins narrow but entire, with a seta-bearing puncture inside margin (on disc) before middle; disc very convex, strongly transversely impressed at base; middle line slightly impressed; surface

punctate across base, impunctate or nearly so elsewhere. *Elytra* ample; width elytra/prothorax 2.15 and 2.16; apices obliquely truncate with outer angles obtuse and inner angles acute-blunted; striae entire, punctate; 3rd intervals with 4 or 5 seta-bearing punctures including 1 near base. *Inner wings* full. *Legs* moderate; tarsi not pubescent above and not sulcate; 4th hind-tarsal segments emarginate but not lobed. *Secondary sexual characters*: ♂ front tarsi narrow, 2-seriately squamulose; last ventral slightly emarginate at apex in ♂, not in ♀, with 1 seta each side in ♂, 2 in ♀. *Measurements*: length *c.* 7.0; width 2.5 mm.

Types. Holotype ♂ (A.M.N.H.) and 1 ♂ paratype (M.C.Z., Type No. 31,511) from Menapi, Cape Vogel Pen., **Papua**, 0–30 m, "No. 1," Aug. 8–11, 1953 (Geoffrey M. Tate); and 1 ♀ paratype from Wasian, Vogelkop, **West N. G.,** Sept. 1939 (Wind, M.C.Z.).

Measured specimens. The ♂ holotype and ♀ paratype.

Notes. For possible relationships of this species, see under genus. This species is smaller and much less punctate and less roughened above than any typical (Australian) *Eudalia* known to me, and the New Guinean species has the outer-apical elytral angles more angulate.

DOBODURA n. gen.

Diagnosis. See *Key to Genera of Colliurini of New Guinea.*

Description. Form (Fig. 131) *c.* as in some *Colliuris*. *Head* without supraocular costae; mandibles long, slender, weakly arcuate; antennae very long, 3rd segments *c.* ¼ longer than 4th segments, 1st segments with 1 long seta near apex; mentum with triangular tooth; ligula rounded, with 2 long setae at apex and 2 shorter setae laterally; paraglossae small, membranous; palpi slender, not pubescent. *Prothorax*: lateral margins entire; median impressed line fine; base deeply transversely channeled with transverse ridge behind channel. *Elytra* spined. *Inner wings* full. *Legs* slender; tarsi not pubescent above, not sulcate above; 4th hind-tarsal segments moderately emarginate, emargination *c.* ½ length of segment; claws not toothed. *Secondary sexual characters*: ♂ front tarsi scarcely dilated, 3 segments narrowly 2-seriately squamulose; last ventral segment of ♂ weakly, of ♀ subcircularly emarginate, with 1 seta each side in ♂, 2 in ♀.

Type species. D. armata (below).

Generic distribution. The single species is known only from **New Guinea**.

Notes. This striking new genus may be related to *Eudalia* but differs in form, longer and less arcuate mandibles, much longer antennae with relatively longer 3rd segments, and presence of elytral spines. The position of the principal spines, *c.* opposite the ends of the 4th intervals rather than at the sutural or outer-apical angles, is unusual in this tribe.

Dobodura armata n. sp.

Description. With characters of genus; form as in Figure 131; black above and below, appendages testaceous except femora dark on inner sides; shining, reticulate microsculpture absent or indistinct on most of upper surface, present and *c.* isodiametric on elytra posteriorly. *Head* 1.07 and 1.06 width prothorax; front evenly convex except slightly impressed anteriorly, impunctate; neck slightly constricted. *Prothorax* suboval, swollen at sides below margins; width/length 0.92 and 0.91; base/apex 1.14 and 1.15; margins each with seta-bearing puncture *c.* ⅔ from apex; disc *c.* evenly convex, impunctate. *Elytra*: width elytra/prothorax 2.00 and 2.09; apices with sutural and outer angles denticulate or short-spined and with long spines *c.* opposite ends 4th intervals; striae entire, formed by lines of fine punctures; 3rd intervals with 3 well spaced seta-bearing punctures. *Secondary sexual characters* as of genus; ♂ copulatory organs as in Figure 180. *Measurements* (types); length (including spines) *c.* 10.5–11.5; width 3.3–3.5 mm.

Types. Holotype ♂ (M.C.Z., Type No. 31,512) and 5 paratypes from Dobodura, **Papua**, Mar.–July 1944 (Darlington); and 2 paratypes, Mt. Hansemann, Astrolabe Bay, **N-E. N. G.** (Biró).

Additional material. **West N. G.**: 1 ♂, mountain slope above Bernhard Camp, 100 m, Apr. 8, 1939 (Toxopeus).

Measured specimens. The ♂ holotype and 1 ♀ paratype from Dobodura.

Notes. My specimens were taken among spray-drenched stones beside small torrents in rain forest.

The specimen from Bernhard Camp has the strial punctures of the elytra coarser than in the types and the tip of the aedeagus slightly different. Additional material may show it to represent a distinguishable subspecies.

Tribe DRYPTINI

Csiki 1932, Coleop. Cat., Carabidae, Harpalinae 7, p. 1548 (see for synonymy and additional references).
Jeannel 1949, Coléop. Carabiques de le Région Malgache, Part 3, p. 1063.
Jedlicka 1963, Ent. Abhandlungen 28, p. 481.
Habu 1967, Fauna Japonica, Carabidae, Truncatipennes Group, p. 266.
Dryptidae Jeannel 1942, Faune de France, Coléop. Carabiques, Part 2, p. 1098.
Dryptinae Basilewsky 1953, Exploration Parc National l'Upemba, Fasc. 10, Carabidae, p. 228.

Members of this small but widely distributed tribe (represented in New Guinea by only 2 genera) are easily recognized by characteristic form (Fig. 132); pubescent surface; antennae with very long 1st and very short 2nd segments; and elytra without raised outer margins. The New Guinean species live chiefly in grass, I think. They are winged and probably diurnal.

Key to Genera of Dryptini of New Guinea

1. Claws simple (p. 216) *Drypta*
– Claws pectinate (p. 218) *Desera*

Genus *DRYPTA* Latreille

Latreille 1796, Précis Caractères Génériques Insectes, p. 75.
Csiki 1932, Coleop. Cat., Carabidae, Harpalinae 7, p. 1548 (see for additional references).
Andrewes 1936, Proc. R. Ent. Soc. London (B) 5, p. 134 (key to "Indian" species).
See also references under tribe.

Diagnosis. See characters given for tribe and in preceding *Key to Genera.*

Description. None required here.

Type species. Carabus dentatus Rossi, of Europe, etc.

Generic distribution. Tropical and warm temperate regions of the **Old World**; 1 species listed from **Brazil**.

Notes. The Oriental-Australian species of *Drypta* are much alike, differing chiefly in proportions and color.

Key to Species of *Drypta* of New Guinea

1. Head, prothorax, and elytra blue-green (p. 216) *papua*
– Head and prothorax red; elytra brown, black, blue-black, or striped 2
2. Elytra broadly longitudinally striped with red (p. 217) *mastersi*
– Elytra not striped 3
3. Less slender (prothoracic width/length *c.* 0.78 or more); femora dark (p. 217) *fumigata*
– More slender (prothoracic width/length *c.* 0.75 or less); femora pale (p. 217) *sulcicollis*

Drypta papua n. sp.

Description. With characters of genus; form as in Figure 132, *c.* average in genus; greenish blue, appendages yellow with apices of femora and of 1st antennal segments narrowly darker; entire upper surface closely punctate. *Head* 1.09 width prothorax; eyes moderate, genae convex. *Prothorax* subcylindric; width/length 0.76; base/apex 1.08; lateral margins indistinct; middle line poorly defined. *Elytra*: width elytra/prothorax 2.09; apices obliquely subtruncate with outer angles obtuse-blunted and sutural angles *c.* right; striae impressed, coarsely very closely punctate; intervals more finely, less closely punctate. *Legs*: tarsi not sulcate above; 4th hind-tarsal segments long-lobed; claws curved, not pectinate, each with obtuse angulation of inner edge near base but with no trace of teeth. *Secondary sexual characters* not determined (♂ unknown). *Measurements*: length 8.5; width 2.7 mm.

Type. Holotype ♀ (M.C.Z., Type No.

31,513) from Lae, **N-E. N. G.,** Oct. 1944 (Darlington); the type is unique.

Notes. I am not sure of the relationships of this unexpected species. In Andrewes' (1936) key to "Indian" species of *Drypta* (see reference under genus), *papua* runs to couplet 18 (19) but fits neither species there named, having a relatively narrower head and broader prothorax than *aetheria* Andrewes (of Assam) and more closely punctate elytral intervals than *cyanopa* Andrewes (of Bengal). *Drypta papua* does not resemble any Australian species of the genus. It does superficially resemble *Desera elegans* Sloane (below) but is smaller, with relatively broader prothorax and obtuse rather than acute outer-apical elytral angles, and of course with simple rather than pectinate tarsal claws.

Drypta mastersi Macleay

Macleay 1871, Trans. Ent. Soc. New South Wales 2, p. 82.
Chaudoir 1877, Bull. Soc. Nat. Moscow 52, Part 1, p. 257.

Description. None required here; note elytra striped with red; length (of New Guinean specimen) *c.* 8.5 mm.

Type. From Gayndah, South Queensland, **Australia**; presumably in Macleay Mus., Sydney (not seen).

Occurrence in New Guinea. **Papua**: 1, Rouku, Morehead R., W. Papua (opposite the tip of Cape York), Apr. 1962 (W. W. Brandt, C.S.I.R.O.).

Notes. In Australia, *mastersi* ranges north at least to mid-peninsular Cape York. I do not know whether it is really distinct from *Drypta australis* Dejean of more-southern Australia.

Drypta fumigata Putzeys

Putzeys 1875, Ann. Mus. Civ. Genoa 7, p. 720.
Chaudoir 1877, Bull. Soc. Nat. Moscow 52, Part 1, p. 258.

Description. None required here; length 13.5–15.0 mm.

Type. From Andai, **Papua**, Aug. 1872 (Beccari and D'Albertis); in Genoa Mus. (not seen).

Occurrence in New Guinea. **Papua**: 3, Dobodura, Mar.–July 1944 (Darlington); 5, Kiunga, Fly R., dates from July 23 to Sept. 25, 1957 (W. W. Brandt, Bishop Mus.); 1, Owen Stanley Rge., Goilala, Bome, 1950 m, Apr. 1–15, 1958 (W. W. Brandt, Bishop Mus.); 1, Popondetta, N. Dist., Jan. 29, 1965 (R. Hornabrook). **N-E. N. G.**: 1, Erima, Astrolabe Bay, 1896 (Biró); 1, Chimbu Vy., Bismarck Rge., 5000–7500 ft. (*c.* 1500–2300 m), Oct. 1944 (Darlington); 1, Aiyura, E. Highlands, 5600 ft. (*c.* 1700 m), "9.10.1960" (J. H. Barrett, Dept. Agr. Port Moresby), at light; 2, Okapa, June 23, 1965 (R. Hornabrook). **West N. G.**: 2, Hollandia, Apr., May 1945 (B. Malkin, U.S.N.M.); 32, Sansapor, Aug. 1944 (Darlington).

Notes. This species is presumably of Oriental origin, but I cannot determine to which Oriental species it is most closely related.

Drypta sulcicollis Putzeys

Putzeys 1875, Ann. Mus. Civ. Genoa 7, p. 721.
Chaudoir 1877, Bull. Soc. Nat. Moscow 52, Part 1, p. 258.

Description. None required here; length *c.* 10.5–11.5 mm.

Type. From Andai, **Papua**, Aug. 1872 (Beccari and D'Albertis) (note locality same as for type of *fumigata*); in Genoa Mus. (not seen).

Occurrence in New Guinea. **Papua**: 1, Dobodura, Mar.–July 1944 (Darlington); 3, Kiunga, Fly R., Aug. 1–3, 14–17, 1957 (W. W. Brandt, Bishop Mus.). **N-E. N. G.**: 1, Erima, Astrolabe Bay, 1897 (Biró); 1, Stephansort, Astrolabe Bay, 1897 (Biró). **West N. G.**: 1, Hollandia-Binnen, 25 m, Oct. 16, 1957 (Gressitt); 1, Humboldt Bay Dist., 1934 (British Mus.); 3, Tor R. (mouth), 4 km E. of Hol Maffen, July 2, 1959 (T. C. Maa, Bishop Mus.), at light; 2, Wasian, Vogelkop, Sept. 1939 (Wind, M.C.Z.).

Notes. This species too is probably derived from an Oriental (not Australian) stock, but I do not know its exact relationships.

Genus *DESERA* Hope

Hope 1831, Zoological Miscellany, p. 21.
Csiki 1932, Coleop. Cat., Carabidae, Harpalinae 7, p. 1553 (see for additional references).
Andrewes 1936, Proc. R. Ent. Soc. London (B) 5, p. 136 (key to "Indian" species).
——— 1939, Ann. Mag. Nat. Hist. (11) 3, p. 133.
Dendrocellus Schmidt-Goebel 1846, Faunula Coleop. Birmaniae, p. 24.

Diagnosis. Characters as of *Drypta*, except claws pectinate.

Description. None required here.

Type species. Desera nepalensis Hope, of SE. Asia (see following *Notes*).

Generic distribution. **SE. Asia** to **Australia**; **Africa**.

Notes. Desera differs from *Drypta* apparently *only* in having pectinate tarsal claws. A modern revision of the species is needed to show whether both genera are really monophyletic and distinct.

Andrewes (1939) outlines the history of the name *Desera*. It was used by Hope (1831) in combination with the valid description of a new species (*nepalensis*, which is therefore the type species), and the combined description includes reference to the pectinate tarsal claws. This use validates *Desera* Hope 1831 under Article 16(a)(VI) of the 1964 edition of the International Code of Zoological Nomenclature.

A single, common species of this genus occurs in New Guinea.

Desera elegans (Sloane)

Sloane 1907, Deutsche Ent. Zeitschrift for 1907, p. 473 (*Dendrocellus*).
Andrewes 1927, Ann. Mag. Nat. Hist. (9) 19, p. 110.

Description (for recognition only). With characters of tribe and genus; form slender; green (sometimes blue-green or bronze-green), antennae red with 1st segment dark at apex, legs red with knees usually darker (legs and antennae sometimes more extensively dark); length *c.* 9.5–10.5 mm.

Type. From Baining Berge, Gazelle Pen., **New Britain**; in Deutsche Ent. Institute, Berlin-Dahlem (Andrewes 1927) (not seen).

Occurrence in New Guinea. Common: 197 specimens from many localities widely scattered over **New Guinea**, from sea level to *c.* 1700 m altitude; occurs at Dobodura and Wau.

Notes. Desera elegans of **New Guinea**, **New Britain**, and **New Ireland** is similar to *geniculata* Klug (SE. Asia to the Moluccas) on one side and to *smaragdula* Chaudoir (Australia) on the other. In fact a single individual from Rouku, Morehead R., West Papua, Apr. 1962 (W. W. Brandt, C.S.I.R.O.) looks more like the Australian *smaragdula* than like the New Guinean *elegans*. Relationships (or identities?) of these and other similar species in the whole Asiatic-Australian area need further study.

Tribe ZUPHIINI

Csiki 1932, Coleop. Cat., Carabidae, Harpalinae 7, p. 1562 (see for synonymy and additional references).
Habu 1967, Fauna Japonica, Carabidae, Truncatipennes Group, p. 253.
Zuphiidae Jeannel 1942, Faune de France, Coléop. Carabiques Part 2, p. 1091.
Zuphiitae Jeannel 1949, Coléop. Carabiques de la Région Malgache, Part 3, p. 1047.
Zuphiinae Basilewsky 1953, Exploration Parc National l'Upemba Fasc. 10, p. 224.

This is another small but widely distributed tribe. Its characters and taxonomic limits need not be discussed here. It is represented in New Guinea by 2 easily recognized genera and a total of 6 known species.

The members of the tribe live in wet places, often among dead leaves on the ground (*Zuphium*) or in grass and vegetation growing in water (*Planetes*). Most species, including all those in New Guinea, are winged.

KEY TO GENERA OF ZUPHIINI OF NEW GUINEA

1. Head subtriangular, very wide at base; elytra not costate (p. 219) ..... *Zuphium*
– Head normal; elytra with many fine costae (p. 220) ..... *Planetes*

Genus *ZUPHIUM* Latreille

Latreille 1806, Genera Crustaceorum et Insectorum 1, p. 198.
Csiki 1932, Coleop. Cat., Carabidae, Harpalinae 7, p. 1562 (see for synonymy and additional references).
Jedlicka 1963, Ent. Abhandlungen 28, p. 477.
See also references under tribe.

Diagnosis. Form (Fig. 133) diagnostic; and see preceding *Key to Genera.*

Description. None required here.

Type species. Carabus olens Rossi, of Europe, etc.

Generic distribution. All tropical and some temperate regions of the **world**.

Notes. The various Oriental and Australian species of *Zuphium* are not well understood. For example, the 7 listed Australian species were all described between 1867 and 1888, most of them from single specimens or single localities, and they have never been revised. The real relationships of the 2 New Guinean species are therefore doubtful, although I have made some comparisons.

Besides the 2 species recorded from New Guinea below, I have seen (British Mus.) 1 specimen of *Zuphium celebense* Chaudoir labeled as from Dory, presumably collected by Wallace. I think this specimen is probably really from Celebes (see Part I of my "Carabid Beetles of New Guinea," pp. 330–331), and I see no reason to list the species from New Guinea even tentatively.

KEY TO SPECIES OF *ZUPHIUM* of NEW GUINEA

1. Large (*c.* 8.3 mm); color piceous (p. 219) . . . . . *thouzeti*
– Small (*c.* 3.5 mm); color brown (p. 219) . . . . . *sinuum*

Zuphium thouzeti Castelnau

Castelnau 1867, Notes on Australian Coleop., p. 17.
——— 1868, Trans. R. Soc. Victoria 8, p. 103.

Description. None required here. Note size large; color dark, not spotted; length (of New Guinean specimen) *c.* 8.3 mm.

Types. From Rockhampton, Queensland, **Australia**; present location of type unknown (not seen).

Occurrence in New Guinea. **Papua**: 1 ♀, Port Moresby, Feb.–May 1943 (W. B. Jones, U.S.N.M.).

Notes. Besides the types from Rockhampton, Castelnau had a specimen from Port Denison (near Bowen) farther north, and I have specimens (identified from description) from W. of Ravenshoe and N. of Mareeba still farther north in Queensland. The Port Moresby specimen agrees reasonably well with my Australian ones except that the color of the legs varies.

Zuphium sinuum n. sp.

Description. Form as in Figure 133, very small; brown, head slightly darker, appendages and lower surface paler; dull, entire upper surface densely microreticulate or roughened. *Head* 0.92 and 0.94 width prothorax; antennae short, middle segments *c.* 2× long as wide; surface densely microreticulate, moderately punctulate. *Prothorax*: width/length 1.13 and 1.10; base/apex 0.88 and 0.81; posterior angles right-acute and not quite basal (base very briefly subpedunculate); surface closely roughened-punctate. *Elytra*: width elytra/prothorax 1.65 and 1.70; apices sinuate at middle of width, lobed between sinuations and suture; surface roughened, striae indicated but not well defined. *Secondary sexual characters*: ♂ front tarsi slightly dilated, 3 segments with soles of dense short squamae; ♂ with 1, ♀ 2 setae each side last ventral segment. *Measurements*: length *c.* 3.5; width 1.3–1.4 mm.

Types. Holotype ♀ (M.C.Z., Type No. 31,514) from Aitape, **N-E. N. G.**, Aug. 1944 (Darlington); and 1 ♂ paratype, Kota Nika, Res. Hollandia, **West N. G.**, Jan. 31, 1956 (R. T. Simon Thomas, Louwerens Coll.).

Measured specimens. The ♂ paratype and ♀ holotype, in this order.

Notes. This species or a close relative occurs also at Cape Gloucester, **New Britain**. Small size, color, dull surface, and sinuate elytral apices distinguish *sinuum* from other comparable species including

celebense Chaudoir (see under genus), in which the elytral apices are scarcely sinuate. *Z. inconspicuum* Schmidt-Goebel of Burma, etc., has strongly sinuate elytral apices but is much more shining than *sinuum*.

Genus *PLANETES* Macleay

Macleay 1825, Annulosa Javanica, p. 28.
Csiki 1932, Coleop. Cat., Carabidae, Harpalinae 7, p. 1567 (see for synonymy and additional references).
Jedlicka 1963, Ent. Abhandlungen 28, p. 464.

Diagnosis. Form *c.* as in Figure 134; elytra each with more than 20 fine longitudinal costae.

Description. None required here.

Type species. P. bimaculatus Macleay, of Java, etc.

Generic distribution. **SE. Asia** including **Ceylon** and **Japan** to northern **Australia**; **Africa**.

Notes. Most and most diverse species of *Planetes* occur in the Oriental Region. Four species, all rather small and unspotted, are known in New Guinea. And only 1 or 2 species, the same as or close to New Guinean forms, have been found in Australia. This geographic pattern suggests dispersal from Asia to Australia.

The species of this genus that I have collected live in swamps and beside standing water. They are winged and often fly to light.

In the present work I have not distinguished *Heteroglossa* Nietner from *Planetes*, although the two probably are distinct (see Habu, 1967, reference cited under tribe).

Key to Species of *Planetes* of New Guinea

1. Smaller, length 6.0–7.5 mm; see also *Description* (p. 220) ..... *secernendus*
– Usually larger; *if* length under 8 mm, 19th (posthumeral) elytral intervals specially conspicuous 2
2. Elytra with an interval (the 19th, near humeri) more conspicuous than others at base; see also *Description* (p. 220) ..... *humeralis*
– Elytra with no single interval more conspicuous than others at base 3
3. Prothorax subcordate, with sides not or weakly sinuate; pronotum more evenly punctate, the punctures rather coarse and of *c.* uniform size (p. 221) ..... *australis*
– Prothorax strongly cordate, with sides strongly sinuate; pronotum less evenly punctate, with coarse and fine punctures mixed (p. 221) ..... *cordens*

Planetes secernendus Oberthür

Oberthür 1883, Notes Leyden Mus. 5, p. 217.

Description (for recognition only). Form small; sparsely inconspicuously pubescent; piceous, not spotted, appendages brownish testaceous; prothorax cordate or subcordate, pronotum unevenly punctate, the punctures varying in size and usually sparser near middle of pronotum; elytra each with more than 20 fine costae, the costae subequal except 1st, 4th, 7th, etc. usually *slightly* wider or more prominent toward base and apex, but 19th costa not specially conspicuous at base; length *c.* 6.0–7.5 mm.

Types. From **Sumatra**; in Oberthür Coll., Paris Mus. (not seen).

Occurrence in New Guinea. Sixty-three specimens from localities (including Dobodura) scattered over most of the length of **New Guinea**; at low altitudes only, none above 500 m.

Notes. P. secernendus is now known from the **Malay Pen.** (British Mus.), **Sumatra**, **Java** (British Mus.), **Borneo**, Leyte and Luzon in the **Philippines** (M.C.Z.), **New Guinea**, and **New Britain** (M.C.Z.). Geographic variation probably occurs but is confused by individual variation especially (in New Guinea) in form and punctation of prothorax. See also *Additional material* and *Notes* under *P. humeralis*, below.

Planetes humeralis n. sp.

Description. With characters of genus; form as in preceding species (*secernendus*), reddish brown, sometimes darker, appendages slightly paler; head and pronotum shining between punctures, elytra duller. *Head* 0.77 and 0.78 width prothorax, weakly impressed across base; front convex, slightly impressed anteriorly, slightly irregularly

finely punctate. *Prothorax* narrowly subcordate; width/length 1.25 and 1.26; base apex 1.06 and 1.05; sides broadly arcuate anteriorly, moderately sinuate posteriorly, with moderate margins, each with usual 2 setae; disc slightly convex, with middle line well impressed but lateral longitudinal impressions vague; baso-lateral impressions moderate, roughened; surface of disc moderately punctate with punctures of mixed sizes, more closely punctate across base and apex. *Elytra* subparallel; width elytra/prothorax 1.35 and 1.37; apices obliquely truncate, outer angles broadly rounded, sutural angles scarcely blunted; each elytron with more than 20 fine costae, the 1st, 4th, 7th, etc., slightly more prominent than others and the 19th specially prominent (but still fine) at base. *Secondary sexual characters*: ♂ front tarsi slightly dilated, 3 segments 2-seriately squamulose; 1 principal seta each side last ventral segment in both sexes. *Measurements* (of types): length 7.3–8.3; width 2.5–2.9 mm.

Types. Holotype ♂ (Bishop Mus.) and 1 ♂ paratype (M.C.Z., Type No. 31,515) from Eliptamin Vy., **N-E. N. G.,** 1200–1350 m, July 16–31, 1959 (W. W. Brandt); 1 ♂ paratype, Torricelli Mts., Mokai Village, **N-E. N. G.,** 750 m, Jan. 1–23, 1959 (W. W. Brandt, Bishop Mus.); 1 ♂ paratype, Mt. Dayman, Maneau Rge., **Papua**, 700 m, "N. Slope No. 6," July 13–20, 1953 (Geoffrey M. Tate, A.M.N.H.).

Additional material. **N-E. N. G.**: 3, Krisa, Vanimo, Apr. 1939 (Cheesman). **West N. G.**: 1, Dojo, 2nd Strip, Res. Hollandia, Apr. 15, 1957 (R. T. Simon Thomas, Louwerens Coll.).

Measured specimens. The ♂ holotype and ♂ paratype from Eliptamin Vy.

Notes. The diagnostic character of this species is the relative conspicuousness of one costa (the 19th) at base of each elytron. Form, color, punctation, and size are also characteristic of the types. However, the individuals listed under *Additional material* are darker and much smaller than the types, *c.* 6.5 mm long. They have the 19th costae relatively conspicuous, as in the types, but otherwise are more like *secernendus*. More material from more localities is needed to show whether these specimens are referable to *humeralis* or to *secernendus*, or whether they represent a separate species. One possibility is that *humeralis* occurs principally at higher altitudes than *secernendus* and that intermediates occur where their ranges overlap.

Planetes australis (Macleay)

Macleay 1871, Trans. Ent. Soc. New South Wales 2, p. 82 (*Polisticus*).

Description. None required here; note size, prothorax with sides weakly or not sinuate; pronotum *c.* evenly rather coarsely punctate; length (in New Guinea) 7.7–9.5 mm.

Type(s). From Rockhampton, Queensland, **Australia**; presumably in Macleay Mus., Sydney (not seen).

Occurrence in New Guinea. **Papua**: 1, L. Daviumbu, Fly R., Sept. 11–20, 1936 (Archbold Exp., A.M.N.H.). **West N. G.**: 1, Kota Nika, Res. Hollandia, Jan. 25, 1956 (R. T. Simon Thomas, Louwerens Coll.), in light trap; 1, Hol Maffin, near Sarmi, July 18, 1959 (T. C. Maa, Bishop Mus.).

Notes. The New Guinean specimens agree reasonably well with specimens from Cairns, North Queensland, identified as *australis* from description.

Planetes cordens n. sp.

Description. With characters of genus; form as in Figure 134, depressed, with wide-cordate prothorax; reddish piceous, appendages paler; surface inconspicuously pubescent (as usual); head and pronotum shining between punctures, elytra dull. *Head* 0.76 and 0.79 width prothorax, irregularly impressed across base; front convex except irregularly impressed anteriorly, with a little irregular fine punctation. *Prothorax*: width/length 1.42 and 1.44; base apex 0.97 and 0.96; sides broadly rounded anteriorly, strongly sinuate posteriorly, mod-

erately margined, with usual 2 setae; posterior angles well defined, right or slightly obtuse; pronotum weakly convex, with well impressed middle line and less distinct longitudinal impressions each side nearer margin than middle; baso-lateral impressions shallow, closely microreticulate; surface of disc otherwise rather closely punctate with mixture of moderate and minute punctures. *Elytra* subparallel; width elytra/prothorax 1.34 and 1.30; apices obliquely truncate with outer angles broadly rounded and inner angles scarcely blunted (as usual); each elytron with more than 20 fine costae, the 1st, 4th, 7th, etc. slightly more prominent than others, but no costa specially conspicuous at base. *Secondary sexual characters* as for *humeralis* (2nd species above). *Measurements*: length *c.* 9.0–9.5; width 3.2–3.3 mm.

Types. Holotype ♂ (Hungarian National Mus.) and 3 paratypes (2 in M.C.Z., Type No. 31,516) from Madang ("Friedrich-Wilh.-hafen"), **N-E. N. G.,** 1896 (Biró); and additional paratypes as follows, all from **N-E. N. G.** (Biró): 1, Stephansort, Astrolabe Bay, 1900; 1, Simbang, Huon Gulf, 1899; 1, Erima, Astrolabe Bay, 1897.

Measured specimens. The ♂ holotype and 1 ♀ paratype from Stephansort.

Notes. Among New Guinean *Planetes*, this should be immediately recognized by rather large size and wide-cordate prothorax with disc flatter than usual and punctate as described. Why Biró should have found this species at four localities while no one else has found it anywhere is a mystery. Perhaps he obtained his specimens in a special habitat by special collecting methods, perhaps by sifting leaf-debris from the ground in rain forest.

Tribe HELLUODINI

Csiki 1932, Coleop. Cat., Carabidae, Harpalinae 7, p. 1571 (see for synonymy and additional references).

This is a small tribe, confined to the tropical Asiatic-Australian area. Only 3 genera are recognized, of which only 1 is represented in New Guinea and (northern) Australia. However, *Holoponerus godeffroyi* (Fairmaire) (1881, Le Naturaliste 3, p. 381; 1883, Ann. Soc. Ent. Belgium 27, p. 2) of New Britain, although considered a lebiine by Fairmaire and listed as one in the Coleopterorum Catalogus (Csiki 1932, p. 1361), may belong in this tribe. I do not know this insect, but the description is of a large carabid (perhaps the largest member of the family in New Britain), 28 mm long, with long mandibles, prothorax expanded at sides, elytra sinuate-truncate and not spined, and head at base with a strong spine on each side. This description suggests a very large *Pogonoglossus*-like carabid with genae, which are prominently angulate or tuberculate in some *Pogonoglossus*, produced as spines.

Genus *POGONOGLOSSUS* Chaudoir

Chaudoir 1862, Bull. Soc. Nat. Moscow 35, Part 2, p. 304.

Csiki 1932, Coleop. Cat., Carabidae, Harpalinae 7, p. 1571 (see for synonymy and additional references).

Andrewes 1937, Bull. Soc. Ent. France for 1937, pp. 152*ff* (with key to species of Java and Sumatra).

Diagnosis. Form including form of eyes characteristic; upper surface at least partly pubescent; antennae not geniculate, with moderate 2nd segments; see description of ligula and paraglossae, below.

Description (characters common to New Guinean species). Form as in Figures 135–140; variably pubescent. *Head*: eyes ± abruptly prominent, genae rounded or angulate-tuberculate behind eyes; 2 setae over each eye; antennae not geniculate, 2nd segments moderate (not very short), segments 1–4 variably setulose, outer segments more densely pubescent; mandibles long, weakly arcuate; neck deeply transversely constricted; front 2-impressed anteriorly; clypeus irregularly truncate, apparently 2- or 4-setose anteriorly (setae difficult to distinguish from other pubescence); labrum variable, 6-setose; mentum with

triangular tooth; ligula short, rounded, with *c.* 4 setae at apex and 2 more near middle of length; paraglossae very slender, much longer than and free from ligula; palpi with apical segments narrowly subtruncate. *Prothorax* cordate or subcordate; apex slightly or moderately (not deeply, in New Guinean species) emarginate, with anterior angles usually rounded (± pointed in some *glabricollis*) and not or not much advanced beyond arc of emargination; base subtruncate or emarginate at middle, ± oblique at sides; posterior angles or sides of prothorax just before angles usually minutely emarginate; margins moderate or wide, reflexed, each with seta at base and before middle; disc usually only weakly convex, with middle line and transverse impressions distinct, baso-lateral impressions present but not sharply defined. *Elytra* quadrate; margins usually faintly subserrate; apices obliquely emarginate-truncate with membranous margins, with outer angles usually rounded (obtuse in *papua*), inner angles *c.* acute or blunted, not armed; striae entire (± obsolete in *unicolor* and *glabricollis*); intervals variably punctate, 3rd with up to 3 or 4 special dorsal punctures (often not distinguishable especially in species with extensive general punctation). *Inner wings* full. *Lower surface* variably punctate-pubescent. *Legs* moderately slender; tarsi pubescent above, not sulcate above; 4th hind-tarsal segments shallowly emarginate; 5th segments setulose above and below; claws simple. *Secondary sexual characters*: ♂ front tarsi not or not much widened, 3 segments narrowly 2-seriately squamulose; ♂ usually with 2 or 3, ♀ 3 or 4 setae each side last ventral segment, but these setae and their punctures sometimes difficult to distinguish.

Type species. *P. validicornis* Chaudoir, of Java.

Generic distribution. **SE. Asia** to northern **Australia**.

Notes. Species of this genus are probably moderately numerous and diverse from the SE. corner of Asia to New Guinea (fewer in northern Australia), but individuals are rarely collected. Of 9 Javan and Sumatran species, Andrewes (1937) saw only single specimens of 6; and of 9 (or 10, with *unicolor* (Macleay)) New Guinean species, I have seen a satisfactory series of only 1. All the New Guinean species appear to be endemic. I compared some of them with the Andrewes Collection in 1948 (see *Notes* under several species, below); none fits the description of *P. horni* Sloane (1907, Deutsche Ent. Zeitschrift for 1907, p. 184) of New Britain; and the 2 Australian species that I have seen are different from any New Guinean species.

KEY TO SPECIES OF *POGONOGLOSSUS* OF NEW GUINEA

1. Elytral striae distinct, impressed 2
– Elytral striae faint or absent 9
2. Genae rounded or irregular behind eyes but not conspicuously angulate or tuberculate (see *Description* of *taylori*) 3
– Genae conspicuously angulate or tuberculate .. 7
3. Entire upper surface including much of head rather closely punctate or (on elytra) roughened 4
– Part or all of upper surface sparsely punctate or impunctate 6
4. Elytra with outer-apical angles obtuse but distinct; size medium (length 9.0–11.5 mm); (found at low altitudes) (p. 224) ..... *papua*
– Elytra with outer-apical angles rounded; size either larger or smaller; (often at higher altitudes) 5
5. Larger, length 12.3–13.0 mm (see also *Description*) (p. 224) ..... *taylori*
– Smaller, length 7.6–8.7 mm (see also *Description*) (p. 225) ..... *minor*
6. Prothorax less wide (width/length 1.49), with moderate margins (p. 225) ..... *major*
– Prothorax very wide (width/length 1.88 and 1.97), with very wide margins (p. 225) .. *latior*
7. Sides of prothorax oblique but scarcely sinuate posteriorly; length *c.* 13 mm (p. 226) ..... *obliquus*
– Sides of prothorax sinuate posteriorly; smaller 8
8. Length 9.6–11.0 mm (p. 226) ..... *grossulus*
– Length 7.0–9.0 mm (p. 227) ..... *parvus*
9. Pronotum densely minutely punctate and pubescent (p. 227) ..... *unicolor*
– Pronotum virtually impunctate and glabrous (p. 227) ..... *glabricollis*

Pogonoglossus papua n. sp.

Description. With characters of genus; form as in Figure 135; brownish black, appendages dark; entire upper surface moderately pubescent, punctate, with reticulate microsculpture indistinct or (on elytra) irregular. *Head* 0.84 and 0.81 width prothorax; genae rounded, not strongly angulate; front moderately punctate, shining between punctures. *Prothorax* strongly cordate; width/length 1.45 and 1.48; base/apex 1.14 and 1.19; base broadly slightly emarginate, slightly oblique at sides; sides strongly sinuate well before base; basal angles sharply formed, *c.* right; margins rather wide, moderately reflexed; disc weakly convex, surface moderately closely punctate-pubescent, less shining than head but more shining than elytra. *Elytra*: width elytra/prothorax 1.46 and 1.46; outer-apical angles obtuse but more distinct than usual in genus, striae moderately impressed, indistinctly punctulate; intervals slightly convex, closely punctate-pubescent. *Secondary sexual characters* as for genus; ♂ with 2, ♀ 3 special seta-bearing punctures each side last ventral segment. *Measurements*: length *c.* 9.0–11.5; width 3.4–4.1 mm.

Types. Holotype ♂ (M.C.Z., Type No. 31,517) and 10 paratypes from Dobodura, **Papua**, Mar.–July 1944 (Darlington); and additional paratypes as follows. **Papua**: 1, without precise locality (Hungarian National Mus.). **N-E. N. G.**: 1, Lae, sea level, July 24, 1955 (Gressitt), in light trap; 1, Busu R., E. of Lae, 100 m, Sept. 13, 1955 (Gressitt); 7, Aitape, Aug. 1944 (Darlington). **West N. G.**: 1, Hollandia, July–Sept. 1944 (Darlington); 2, same locality, May 1945 (H. Hoogstraal, M.C.Z.); 1, same locality, June 1945 (B. Malkin, U.S.N.M.); 3, same locality, dates in Nov., Dec., Jan. 1944–1945 (W. T. Nailon, Fenton Coll.); 1, Sentani, 90+ m, June 22, 1959 (Gressitt and T. C. Maa, Bishop Mus.), in light trap; 1, Hol Maffin, near Sarmi, July 18, 1959 (T. C. Maa, Bishop Mus.); 1, Neth. N. G. without further locality, Oct. 10, 1944 (T. Aarons, Cal. Acad.). Also 1, "Sinimi" (= Senimi R., Papua?), "⅕ 1943" (T. Niimura, Uéno Coll.).

Measured specimens. The ♂ holotype and 1 ♀ paratype from Dobodura.

Notes. In Andrewes' key (1937, see reference under genus), this species runs to *latus* Andrewes of Sumatra but has the prothorax probably narrower at base and less emarginate at apex and the pronotum certainly more closely punctate. Of Australian species, *papua* is closest to *porosus* Sloane (I have specimens, identified from description, from Rocky R., mid-peninsular Cape York) but has a more strongly cordate prothorax and better defined outer-apical elytral angles.

Since *papua* is the common *Pogonoglossus* in New Guinea, I shall take it as a standard for comparison of several of the following species.

Most of my Dobodura specimens were taken in piles of dead leaves on the ground in rain forest.

Pogonoglossus taylori n. sp.

Description. With characters of genus; form and characters *c.* as preceding species (*papua*) except as follows. *Head* 0.75 and 0.78 width prothorax; genae more prominent than in *papua*, nearly wide as eyes, minutely tuberculate and *c.* subangulate behind eyes. *Prothorax*: width/length 1.44 and 1.58; base/apex 1.18 and 1.18; apex slightly more emarginate than in *papua* and sides slightly more broadly and evenly reflexed. *Elytra*: width elytra/prothorax 1.43 and 1.43; outer-apical angles more rounded than in *papua*. *Measurements*: length 12.3–13.0; 4.3–4.9 mm.

Types. Holotype ♂ (M.C.Z., Type No. 31,518) from Aiyura, **N-E. N. G.**, 1900 m, July 1962 (R. W. Taylor, #2147), in rain forest; 1 ♀ paratype, Eliptamin Vy., **N-E. N. G.**, 1665–2530 m, June 23–30, 1959 (W. W. Brandt, Bishop Mus.); 1 ♂ paratype, Okapa, **N-E. N. G.**, Aug. 29, 1965 (R. Hornabrook).

Measured specimens. The ♂ holotype and ♀ paratype from Eliptamin Vy.

Notes. This is apparently a mountain-living species probably related to the lowland *papua* but differing from it as indicated in the *Description* above.

Pogonoglossus minor n. sp.

Description. With characters of genus (except ♂ unknown); form *c.* as in *papua*; characters *c.* as in *papua* except as follows. Color browner (less black), surface slightly more shining. *Head* 0.88 and 0.86 width prothorax; eyes slightly smaller and genae more evenly rounded than in *papua*. *Prothorax*: width/length 1.47 and 1.49; base apex 1.08 and 1.07. *Elytra*: width elytra prothorax 1.50 and 1.51; outer-apical angles more rounded than in *papua*; intervals less roughened. *Measurements*: length 7.6–8.7; width 3.0–3.3 mm.

Types. Holotype ♀ (M.C.Z., Type No. 31,519) from lower Busu R., Huon Pen., **N-E. N. G.,** May 12, 1955 (E. O. Wilson), in lowland rain forest; 1 ♀ paratype, Wau, Morobe Dist., **N-E. N. G.,** 1200 m, June 22, 1961 (Sedlaceks); 1 ♀ paratype, Hollandia, **West N. G.,** Jan. 20, 1945 (W. T. Nailon, Fenton Coll.); 1 ♀ paratype, Njau-limon, S. of Mt. Bougainville, **West N. G.,** 300 ft., Feb. 1936 (Cheesman).

Measured specimens. The ♀ holotype and ♀ paratype from Njau-limon.

Notes. P. minor differs from *papua* as indicated in the preceding *Description*. The 2 species are sympatric but *minor* is apparently the less widely distributed, being known only from a comparatively small part of east-central New Guinea.

P. minor is similar also to *porosus* Sloane of North Queensland, Australia, but has the head more punctate and the prothorax more strongly cordate.

Pogonoglossus major n. sp.

Description. With characters of genus; form as in Figure 136; irregular brownish piceous, appendages dark brown; rather shining, reticulate microsculpture absent or indistinct on head and pronotum, light, irregular, moderately transverse on elytra; surface punctate as described below. *Head* 0.82 width prothorax; genae prominently rounded but not angulate; front sparsely punctate-pubescent. *Prothorax* weakly cordate; width/length 1.49; base/apex 1.05; sides broadly sinuate before obtuse except minutely subdenticulate posterior angles; surface irregularly rather sparsely punctate-pubescent. *Elytra*: width elytra/prothorax 1.44; outer-apical angles broadly rounded, sutural angles blunted; striae deep, entire, finely punctulate; intervals convex, sparsely punctate, 3rd with apparently 3 or 4 special dorsal punctures difficult to distinguish from other punctures. *Secondary sexual characters*: ♂ front tarsi as genus; ♂ with apparently 3 principal setae on left, 4 on right side last ventral segment; ♀ unknown. *Measurements*: length 17.5; width 6.0 mm.

Type. Holotype ♂ (M.C.Z., Type No. 31,520) from vic. Nadzab, **N-E. N. G.,** July 1944 (Darlington); the type is unique.

Notes. This is the largest New Guinean *Pogonoglossus*. It is about the size of *P. horni* Sloane (Deutsche Ent. Zeitschrift for 1907, p. 184) of New Britain but has the prothorax more narrowed behind with more obtuse posterior angles, the outer elytral striae not fainter, and the elytral intervals sparsely rather than closely setose-punctate.

Pogonoglossus latior n. sp.

Description. With characters of genus; form as in Figure 137, very broad; brownish black, appendages dark; moderately shining, reticulate microsculpture indistinct on head and pronotum, light, fine, rather strongly transverse on elytra; punctation as described below. *Head* 0.74 and 0.67 width prothorax; genae oblique for most of length, slightly rounded or very obtusely subangulate behind eyes; front *c.* impunctate except sparsely punctate laterally and posteriorly. *Prothorax* very wide, cordate; width/length 1.88 and 1.97; base/apex 1.24

and 1.12; sides strongly but variably sinuate well before *c.* right or obtuse posterior angles; margins widely reflexed; disc more convex than usual, sparsely inconspicuously punctate-pubescent. *Elytra*: width elytra prothorax 1.45 and 1.30; outer-apical angles rounded, sutural angles blunted; striae entire, well impressed, slightly irregular but scarcely punctulate; intervals convex, sparsely inconspicuously punctulate, 3rd with 3 or 4 dorsal punctures difficult to distinguish. *Secondary sexual characters*: ♂ front tarsi as for genus; ♂ with 3, ♀ 4 setae each side last ventral segment. *Measurements*: length 14.5–15.5; width 5.7–6.0 mm.

Types. Holotype ♂ (Leiden Mus.) and 1 ♀ paratype (M.C.Z., Type No. 31,521) from Lower Mist Camp, Snow Mts., **West N. G.,** 1550 m, Jan. 31, 1939 (Toxopeus).

Notes. See *Key to Species* for distinguishing characters of this well defined species. The ♀ has a wider prothorax with more obtuse angles than the ♂, but this is probably individual rather than sexual variation. I have no doubt the 2 specimens are conspecific.

Pogonoglossus obliquus n. sp.

Description. With characters of genus; form as in Figure 138; black, appendages dark; shining, reticulate microsculpture absent or indistinct even on elytra; punctation as described below. *Head* 0.77 width prothorax; genae prominently angulate-tuberculate behind eyes; front almost smooth, very sparsely punctulate-pubescent. *Prothorax* very wide; width/length 2.00; base/apex 1.22; sides oblique and converging and scarcely sinuate before obtuse posterior angles; margins widely reflexed; disc moderately convex, sparsely punctate-pubescent, more closely so across base and apex. *Elytra*: width not measured (specimen broken); humeral margins wider than usual; outer-apical angles rounded, sutural angles acute, scarcely blunted; striae entire, impressed, irregular but scarcely punctulate; intervals convex, finely sparsely punctulate, 3rd with *c.* 3 special dorsal punctures difficult to distinguish. *Secondary sexual characters*: ♂ front tarsi as for genus; ♂ with 3 setae each side last ventral segment; ♀ unknown. *Measurements*: length *c.* 13 mm; width not measured.

Type. Holotype ♂ (Bishop Mus.) from Eliptamin Vy., **N-E. N. G.,** 1665–2530 m, June 23–30, 1959 (W. W. Brandt); the type is unique.

Notes. The single specimen was received in bad condition and remounted in pieces on a card, but it shows the essential characters of this very distinct species. See *Key to Species* for its differential characters.

Pogonoglossus grossulus n. sp.

Description. With characters of genus; form average; black or brownish black, appendages dark; shining, reticulate microsculpture indistinct even on elytra. *Head* 0.80 and 0.79 width prothorax; genae prominently angulate-tuberculate behind eyes; front virtually smooth at middle, very sparsely punctulate-setose at sides. *Prothorax* wide-cordate; width/length 1.95 and 1.94; base/apex 1.23 and 1.19; sides broadly sinuate before *c.* right or obtuse posterior angles; margins wide, widely reflexed; disc weakly convex, very sparsely punctulate-pubescent. *Elytra*: width elytra/prothorax 1.27 and 1.36; outer-apical angles rounded, sutural angles acute (except for membranous margins); striae deep, scarcely punctulate; intervals convex, very sparsely punctulate, 3rd with up to 3 special dorsal punctures difficult to distinguish. *Secondary sexual characters* as for genus; ♂ with 2, ♀ with 3 setae each side last ventral segment. *Measurements*: length 9.6–11.0; width 3.7–4.1 mm.

Types. Holotype ♀ (M.C.Z., Type No. 31,522) from vic. Zengaru, Vy. of Kua R., Mongi Watershed, Huon Pen., **N-E. N. G.,** 800 m, Apr. 14, 1955 (E. O. Wilson); 1 ♀ paratype, Lae, **N-E. N. G.,** July 1944 (F. E. Skinner, Purdue U. Coll., borrowed fr. Bishop Mus.); 1 ♂ paratype, Kokoda,

Papua, 1200 ft. (366 m), Sept. 1933 (Cheesman).

Measured specimens. The ♂ paratype and ♀ holotype, in this order.

Notes. Although the 3 individuals listed above vary somewhat, they agree in form of genae, wide-cordate prothorax, shining sparsely punctate surface, and moderate size. I think they probably represent a single, variable species.

Pogonoglossus parvus n. sp.

Description. With characters of genus; form as in Figure 139; brownish black, head with 2 narrow oblique red marks posteriorly (see following *Notes*), appendages dark brown; moderately shining, reticulate microsculpture indistinct on head, irregular or transverse and light on pronotum and elytra. *Head* 0.85 and 0.85 width prothorax; genae angularly prominent behind eyes; much of front virtually impunctate. *Prothorax* cordate; width/length 1.48 and 1.56; base apex 1.21 and 1.23; sides broadly sinuate before obtuse or nearly right posterior angles; margins rather narrow and not strongly reflexed; disc moderately convex, finely punctate-pubescent (pubescence rubbed off in part in holotype). *Elytra*: width elytra/prothorax 1.34 and 1.35; outer-apical angles narrowly rounded, sutural angles acute or slightly blunted; striae well impressed, irregular but scarcely punctulate; intervals convex, sparsely punctulate-pubescent, 3rd with special dorsal punctures not surely distinguishable. *Secondary sexual characters* as for genus; ♂ with 2 or 3 (unsymmetric), ♀ 3 setae each side last ventral segment. *Measurements*: length 7.0–9.0; width 2.5–3.2 mm (the ♂ is the larger).

Types. Holotype ♂ (M.C.Z., Type No. 31,523) from vic. Hollandia, **West N. G.**, July–Sept. 1944 (Darlington); and 1 ♀ paratype, Dobodura, **Papua**, Mar.–July 1944 (Darlington).

Notes. The small size, angulate genae, and form and microsculpture distinguish this species. The red marks on the head are distinct in both specimens and may prove to be characteristic of the species, although similar marks are indicated in some individuals of some other species.

Pogonoglossus unicolor (Macleay)

Macleay 1886, Proc. Linnean Soc. New South Wales (2) 1, p. 137 (*Planetes*).

Sloane 1907, Deutsche Ent. Zeitschrift for 1907, p. 184.

Description (significant details only, from Macleay's description). Color brownish black, legs dark; head shining, pronotum and elytra dull and densely minutely punctate; prothorax a little wider than long, with sides narrowed to posterior angles which are "rather obtusely rectangular"; elytra "with 8 or 9 almost invisible striae"; length *c.* 10 mm.

Type. From Fly R. (probably **Papua**); should be in Macleay Mus., Sydney (not seen).

Notes. Sloane (1907) adds nothing to Macleay's description of *unicolor* except that the insect is a *Pogonoglossus*. The very lightly striate elytra distinguish it from all known New Guinean species of this genus except *glabricollis* Van Emden (below), from which it differs in having the pronotum densely punctate and pubescent rather than smooth and virtually glabrous as in *glabricollis*.

Pogonoglossus glabricollis Van Emden

Van Emden 1937, Stettiner Ent. Zeitung 98, p. 44.

Description. With characters of genus; form as in Figure 140 (but somewhat variable); irregular dark brown or brownish black, head with 2 reddish marks posteriorly, appendages brown; moderately shining, elytra duller, reticulate microsculpture indistinct on head and pronotum, light and irregular on elytra. *Head* 0.85 and 0.83 width prothorax; genae rounded; front almost impunctate. *Prothorax* cordate, variable; width/length 1.39 and 1.60 (*sic*); base apex 0.98 and 1.07; sides broadly sinuate before obtuse or *c.* right posterior

angles; margins rather narrow but variable; anterior angles rounded or bluntly pointed; disc almost flat, scarcely punctulate. *Elytra*: width elytra/prothorax 1.35 and 1.37; outer-apical angles broadly rounded, sutural angles acute or blunted; striae faintly indicated or virtually obsolete; surface closely punctulate; up to 3 apparent dorsal punctures sometimes visible on position of 3rd intervals. *Secondary sexual characters* undetermined (♂ unknown); ♀ with 3 or 4 (sometimes unsymmetric) setae each side last ventral segment. *Measurements*: length 12.5–16.0; width 4.2–5.3 mm.

Type. A ♀ from **N-E. N. G.**; in Van Emden Coll., British Mus. (seen).

Occurrence in New Guinea. **Papua**: 1 ♀, Kokoda-Pitoki, 400 m, Mar. 23, 1956 (Gressitt); 1 ♀, Fiume Purare, Jan. 1894 (Loria, borrowed from Straneo). **N-E. N. G.**: the holotype; 1 ♀, Motae, Kuku Kuku, E. Highlands, 6000 ft. (*c.* 1830 m), "1/3/64" (R. Hornabrook). **West N. G.**: 1 ♀, Geelvink Bay, 1878 (Raffray and Maindron, Paris Mus.).

Measured specimens. The ♀♀ from Kokoda-Pitoki and Motae.

Notes. Although the 4 individuals listed above vary in several characters (e.g. form of prothorax, degree of obliteration of elytral striae), the variations are not obviously concordant, and I think only one very distinct species is involved. It is uniquely characterized by form, elytral striae faint or obsolete, and combination of virtually impunctate pronotum and densely punctulate elytra.

Tribe HELLUONINI

Sloane 1914, Proc. Linnean Soc. New South Wales 39, p. 568.

Csiki 1932, Coleop. Cat., Carabidae, Harpalinae 7, p. 1572 (see for synonymy and additional references).

Jeannel 1949, Coléop. Carabiques de la Région Malgache, Part 3, p. 1041.

Jedlicka 1963, Ent. Abhandlungen 28, p. 467.

Helluoninae Basilewsky 1953, Exploration Parc National l'Upemba, Fasc. 10, p. 219.

This is still another small but widely distributed tribe. The members of it are medium-sized or large carabids, usually of characteristic form, usually with sparse or short pubescence, and usually with mouthparts including the labrum strikingly modified. Three genera are confined to the Americas; 6, to Africa and/or the Oriental Region (except that a species of *Creagris* extends to Australia); 13, to the Australian Region. (A supposed helluonine on New Caledonia has been shown not to be one by Britton, 1937, Ent. Monthly Magazine 73, p. 127.) The Australian genera form a distinct group of the tribe, characterized by Sloane (1914, p. 570). Five genera (1 of them new) and 8 species of Australian-group Helluonini occur in New Guinea, where the only other member of the tribe is *Creagris labrosa*, which ranges from Ceylon and India to Australia.

In spite of Sloane's (1914) careful study of the Australian genera, I have had trouble with the generic classification of the New Guinean forms. This is partly because my material is inadequate: 2 obviously distinct new species are represented by unique females which I have assigned to *Helluonidius* with some doubt, and I have been forced to base an apparent new genus on a single male. I myself found no Helluonini during 11 months in New Guinea and I can say nothing about their habitats or habits there except that all the New Guinean species are winged and that some of them fly to light. In Australia, different helluonines live on the ground and on tree trunks, usually in open or openly-wooded places rather than in rain forest.

Key to Genera of Helluonini of New Guinea

1. Front femora not angulate-protuberant below; size smaller, length *c.* 9 mm (p. 229) *Creagris*
– Front femora thickened and bluntly angulate or protuberant below near base; size larger 2
2. Prothorax moderately narrowed posteriorly, with sides moderately sinuate (p. 233) ... *Helluodema*

– Prothorax strongly narrowed posteriorly, with sides strongly sinuate and base subpedunculate 3

3. Ligula subtriangular, narrowed anteriorly, with apex narrowly rounded (p. 233) ..... *Helluosoma*

– Ligula very wide, with apex broadly rounded or emarginate 4

4. Labrum with 2 principal setae; elytra with 8th intervals much wider than 7th and closely punctate; length (in New Guinea) *c.* 30 mm (p. 233) ..... *Gigadema*

– Labrum with 4 or more principal setae; elytra with 8th intervals not much wider than 7th and less closely punctate; length *c.* 20 mm or less 5

5. Tarsal segments unusually widened or parallel-sided, the 4th hind-tarsal segments emarginate for more than ½ the segments' length; labrum usually with 4 principal setae (p. 229) ..... *Helluonidius*

– Tarsal segments not thus widened and not parallel-sided, the 4th hind-tarsal segments shallowly emarginate; labrum with *c.* 10 principal setae (see also *Description*) (p. 232) ..... *Helluopapua*

Genus *CREAGRIS* Nietner

Nietner 1857, J. Asiatic Soc. Bengal 26, p. 139.
Csiki 1932, Coleop. Cat., Carabidae, Harpalinae 7, p. 1575 (see for synonymy and additional references).

Diagnosis. See preceding *Key to Genera.*

Description. None required here.

Type species. Creagris labrosa Nietner, below.

Generic distribution. Six species in the **Oriental Region**, 1 of them extending to **New Guinea** and Queensland, **Australia**; possibly an additional species in Queensland.

Notes. The listing of *C. wilsoni* Castelnau (the supposed endemic Queensland species) also from Java by Csiki (p. 1576) is apparently a compiler's error based on a misreading of Sloane 1914 (see reference under following species).

Creagris labrosa Nietner

Nietner 1857, J. Asiatic Soc. Bengal 26, p. 139.
Sloane 1914, Proc. Linnean Soc. New South Wales 39, p. 570.
——— 1920, Proc. Linnean Soc. New South Wales 45, p. 322.
Csiki 1932, Coleop. Cat., Carabidae, Harpalinae 7, p. 1575 (see for synonymy and additional references).

Description. None required here; note size small; color dark brown; labrum expanded, *c.* circular, shallowly channeled each side; mentum with lateral lobes and median tooth all produced as long very slender processes; front femora not angulate below; length *c.* 9 mm.

Types. From **Ceylon**; in Berlin U. Zool. Mus. and Stettin Mus. (not seen).

Occurrence in New Guinea. **Papua**: 2, Mt. Lamington, 1300–1500 ft. (*c.* 400–460 m) (C. T. McNamara, S. Australian Mus.).

Notes. C. labrosa is now known from **Ceylon**, **India**, **Burma**, etc., **Java**, **New Guinea**, and Queensland, **Australia** (a specimen from Mackay, recorded by Sloane, 1914).

Genus *HELLUONIDIUS* Chaudoir

Chaudoir 1872, Revue et Magasin Zool. (2) 23, p. 216.
Sloane 1914, Proc. Linnean Soc. New South Wales 39, pp. 571, 582.
Csiki 1932, Coleop. Cat., Carabidae, Harpalinae 7, p. 1580 (see for synonymy and additional references).

Diagnosis. Form *c.* as in Figure 142; pubescent (as usual in tribe); genae variable; labrum variable, produced or angulate at apex, usually with 4 principal setae; mentum toothed; ligula rounded; prothorax strongly constricted at base; elytra with 8th intervals not much wider than 7th, irregularly punctate; 4th hind-tarsal segments ± wide, deeply emarginate; see also preceding *Key to Genera of Helluonini of New Guinea.*

Description. None attempted here; material inadequate.

Type species. Aenigma cyanipenne Hope, of Australia.

Generic distribution. Eastern and northern **Australia**, **New Guinea**.

Notes. Of the 4 New Guinean species now placed in this genus, only *chrysocomes* Maindron is a typical *Helluonidius.* The other 3 species, 2 of them based on unique

females (sex determined by dissection), differ in form of labrum and differ among themselves in form of genae, form of tarsi, and in other ways. They are obviously distinct species, but males are needed to determine generic assignments.

KEY TO SPECIES OF *HELLUONIDIUS* OF NEW GUINEA

1. Labrum longer than wide, narrowly produced at apex (p. 230) ..... *chrysocomes*
– Labrum wider than long, not narrowly produced at apex 2
2. Labrum with median setae close to margin; elytra microreticulate (p. 230) *laevifrons*
– Labrum with median setae *c.* ⅓ labrum's length behind margin; elytra not microreticulate 3
3. Genae abruptly truncate, *c.* straight from posterior edges of eyes to neck; tarsi very wide (Fig. 184) (p. 231) *latipes*
– Genae moderately convex; tarsi less wide (p. 231) *politus*

Helluonidius chrysocomes Maindron

Maindron 1908, Nova Guinea 5, Livraison 2, p. 299.

Description. None required here; form as in Figure 142; form of labrum (longer than wide, and narrowly produced at apex) unique in tribe Helluonini in New Guinea; genae prominent; antenna and hind tarsus, Figure 182; color black or dark brown; surface without reticulate microsculpture; length *c.* 16.0–18.5 mm.

Type. From "Sentani" (near Hollandia), **West N. G.**; probably in Paris Mus. (not seen).

Occurrence in New Guinea. Twenty-two specimens from 11 localities scattered over most of the length of **New Guinea**, from Port Moresby and the Fly R. to the Vogelkop; at low altitudes, none labeled higher than 800 m (Araucaria Camp).

Notes. This is a typical *Helluonidius*, very close to and perhaps the same as one of the Australian species, which are all very similar and which need revision.

Most specimens of *chrysocomes* have the surface especially of the elytra with a pearly luster which is apparently due to a surface film of some sort, but 6 individuals widely scattered within the range of the species are shining black without luster.

Helluonidius laevifrons n. sp.

Description. With characters of genus; form as in Figure 143; antenna and hind tarsus, Figure 183; black, appendages dark; head and pronotum shining (but punctate as described below), elytra duller, with *c.* isodiametric microsculpture. *Head* 0.84 width prothorax; genae oblique, not at all prominent; clypeus subtruncate, 1-setose each side; labrum wider than long, obtusely subangulate, sinuate each side of angulation, 4-setose with inner setae very close to anterior margin (see *Notes*, below); front deeply impressed each side, the impressions punctate but front otherwise broadly impunctate; neck moderately impressed and punctate; mentum with large triangular tooth; ligula wide, irregularly rounded, depressed at middle, with 3 pairs seta-bearing punctures one behind the other; inner lobe of maxillae with inner edge irregular near middle and with strong hook at *c.* right angles from inner-apical angle; palpi rather short and thick. *Prothorax*: width/length 1.19; base/apex 1.02; base/head 0.72; margins narrow, scarcely interrupted; disc irregularly convex, irregularly coarsely punctate with punctures tending to form longitudinal rows between narrow smooth spaces at middle. *Elytra*: width elytra/prothorax 1.22; striae well impressed, punctulate; intervals slightly convex, most intervals slightly irregularly 2-seriately punctate, special dorsal punctures of 3rd not surely distinguishable, 8th slightly wider than 7th and irregularly (not 2-seriately) punctulate. *Legs*: tarsal segments more nearly parallel than usual (Fig. 183); 4th hind-tarsal segments emarginate for slightly more than ½ length. *Measurements*: length 18.0; width 6.5 mm.

Type. Holotype ♀ (Bishop Mus.) from Torricelli Mts., Mokai Village, **N-E. N. G.**, 750 m, Jan. 1–23, 1959 (W. W. Brandt); the type is unique.

Notes. The front margin of the labrum

is slightly sinuate on each side, with the inner seta-bearing puncture near margin at the sinuation. This form of labrum is intermediate between that of *H. chrysocomes* and those of the following two species. But in some other ways (form of genae and especially form of tarsi) the present species is strongly characterized, not intermediate.

Helluonidius latipes n. sp.

Description. With characters of genus; form as in Figure 144; antenna and hind tarsus, Figure 184; dark brown, appendages dark; shining, without reticulate microsculpture, but punctate as described below. *Head* 0.82 width prothorax; genae oblique, not at all prominent; clypeus subtruncate, 2-setose each side; labrum wider than long, bluntly obtusely angulate, not sinuate at sides of angulation, 4-setose with inner setae almost ⅓ length of labrum behind anterior margin; front irregularly convex, deeply impressed each side anteriorly, punctate at sides and base but *c.* impunctate at middle; mentum with strong bluntly triangular tooth; ligula wide, rounded, scarcely impressed at middle, probably 6-setose as in *laevifrons* (above) but anterior setae covered or broken; inner lobe of maxillae *c.* as in *laevifrons*; palpi stout. *Prothorax*: width/length 1.40; base/apex 1.01; base/head 0.72; margins narrow, much interrupted anteriorly; disc irregularly convex, irregularly punctate. *Elytra*: width elytra/prothorax 1.52; striae impressed, scarcely punctulate; intervals slightly convex, irregularly 2-seriately punctate, 3rd with special dorsal punctures not surely distinguishable, 8th not wider than 7th, irregularly, rather sparsely in part 2-seriately punctate. *Legs*: tarsi exceptionally wide (Fig. 184); 4th hind-tarsal segments much wider than long, deeply and widely emarginate; 5th segments wide and flattened. *Measurements*: length 19.8; width 6.8 mm.

Type. Holotype ♀ (Leiden Mus.) from Rattan Camp, **West N. G.,** 1200 m, Feb.–Mar. 1939 (Toxopeus); the type is unique.

Notes. This species is assigned to *Helluonidius* with doubt. The genae are formed as in the preceding species (*laevifrons*) and the labrum is almost the same in shape, but the 2 inner setae of the labrum are much farther back and the tarsi are strikingly different.

Helluonidius politus n. sp.

Description. With characters of genus; form as in Figure 145; antenna and hind tarsus, Figure 185; brownish black, appendages dark; shining, without reticulate microsculpture but punctate as described below. *Head* 0.84 width prothorax; genae moderately convex, subprominent; clypeus broadly slightly emarginate, 2-setose each side; labrum wider than long, bluntly angulate, with apparently 2 principal setae on right and 4 on left, the inner seta on each side almost ⅓ length of labrum behind anterior margin; front weakly convex, deeply impressed each side anteriorly, punctate at sides and across base and with a few widely scattered punctures near middle; mentum with strong blunt tooth; ligula wide, rounded, scarcely impressed, 6-setose as in *laevifrons*; inner lobe of maxillae *c.* as in *laevifrons* and *latipes*, with hook from inner-apical angle; palpi less thick than in preceding species. *Prothorax*: width/length 1.33; base/apex 0.97; base/head 0.68; margins narrow, much interrupted anteriorly; disc weakly irregularly convex, irregularly coarsely punctate. *Elytra*: width elytra/prothorax 1.44; striae impressed, punctulate; intervals convex, irregularly 2-seriately punctate, 3rd with special dorsal punctures not surely identifiable, 8th not much wider than 7th, irregularly in part 2-seriately sparsely punctate. *Legs*: tarsi moderately wide and flattened, but less so than in preceding species (*latipes*); 4th hind-tarsal segments wide, very deeply emarginate. *Measurements*: length 16.7; width 5.3 mm.

Type. Holotype ♀ (M.C.Z., Type No. 31,524), from Maba Vy., Menyama, Mo-

robe Dist., **N-E. N. G.** (L. Hastings); 1 ♂ paratype (Bishop Mus.), Oriomo River, 6 m, Feb. 13, 1964 ("H.C."), light trap; 1 ♀ paratype (M.C.Z.), Maprik, **N-E. N. G.**, Oct. 14, 1957 (Gressitt), light trap.

Notes. This species is similar to the preceding (*latipes*) but has more prominent genae and narrower tarsi. The genae are less prominent than in *chrysocomes* but lead toward that species, while the labrum suggests a relationship with *latipes*.

HELLUOPAPUA n. gen.

Diagnosis. Form of *Helluonidius*; labrum wide, multisetose; ligula wide, slightly emarginate, setose as in *Helluonidius*; inner lobe maxillae strongly hooked on inner side *before* apex; 8th elytral intervals *c.* wide as 7th, 2-seriately punctate with few or no scattered punctures; tarsi slender, 4th hind-tarsal segments shallowly emarginate; front femora obtusely prominent below near base; ♂ front tarsi without squamae; ♂ copulatory organs as in Figure 181.

Description. See description of only known species, below.

Type species. H. toxopei, below.

Generic distribution. Known from a single locality in **West N. G.**

Notes. This new genus differs from *Helluonidius* in labrum multisetose; hook of inner lobe of the maxillae subapical (not apical), and tarsi much more slender with 4th hind-tarsal segments shallowly (not deeply) emarginate. It differs from *Gigadema* in labrum multisetose and 8th elytral intervals much narrower and 2-seriately (not densely) punctate. It fits no other genus in Sloane's (1914, pp. 571–572) key. And it differs from all previously known Helluonini of Sloane's (1914, p. 570) "Australian Group" in lacking sexual squamae on ♂ front tarsi.

Helluopapua toxopei n. sp.

Description. With characters of genus; form as in Figure 146; slender, subparallel, depressed; antennae and hind tarsus, Figure 186; black, appendages dark brown, 2 minute red spots on head posteriorly; surface sparsely pubescent, moderately shining, microsculpture faint and irregular on head and pronotum, more distinct and *c.* isodiametric on elytra, and surface punctate as described below. *Head* 0.90 width prothorax; genae rounded, moderately prominent; clypeus slightly sinuate-truncate, with several setae each side; labrum wider than long, wide in front, broadly sinuate each side in front with apex obtusely angulate, with several principal setae each side but none near middle; front irregularly convex, deeply impressed each side and transversely impressed anteriorly (individual character?), irregularly punctate at sides and posteriorly; mentum with strong triangular tooth and side lobes long and pointed; ligula as described for genus; palpi rather slender. *Prothorax*: width/length 1.38; base/apex 0.78; base/head 0.69; margins narrow, not interrupted; disc weakly irregularly convex, surface irregularly punctate. *Elytra*: width elytra/prothorax 1.52; striae impressed, not punctulate; intervals slightly convex, rather sparsely 2-seriately punctate. *Measurements*: length 22.5; width 6.7 mm.

Type. Holotype ♂ (sex determined by dissection) (Leiden Mus.) from Rattan Camp, **West N. G.,** 1200 m, Feb.–Mar. 1939 (Toxopeus); the type is unique.

Notes. Although this ♂ is from the same locality as the ♀ type of *Helluonidius latipes*, the two specimens differ in so many ways that they cannot be one species but have to be assigned to different genera: the two specimens differ in form, in genae, in shape and setae of labrum, in position of hook of inner lobe of maxillae, and in form of tarsi, and this is just a beginning of the list of differences. A revision of all New Guinean and Australian members of the tribe, with much additional material, will probably be necessary to decide the real relationships of this new genus as well as of the new species of *Helluonidius* described above.

Genus *HELLUOSOMA* Castelnau

Castelnau 1867, Notes on Australian Coleop., p. 20.
Sloane 1914, Proc. Linnean Soc. New South Wales 39, pp. 571, 585.
Csiki 1932, Coleop. Cat., Carabidae, Harpalinae 7, p. 1581 (see for synonymy and additional references).

Diagnosis. See preceding *Key to Genera.*

Description. None required here.

Type species. H. atrum Castelnau (below).

Generic distribution. Tropical **Australia** and **New Guinea**.

Notes. Only one species of this genus is adequately known, although a second species may exist in Australia (Sloane 1914, p. 586).

Helluosoma atrum Castelnau

Castelnau 1867, Notes on Australian Coleop., p. 21.
Sloane 1914, Proc. Linnean Soc. New South Wales 39, p. 586.
Csiki 1932, Coleop. Cat., Carabidae, Harpalinae 7, p. 1581 (see for synonymy and additional references).

Description. None required here; note form *c.* as in *Helluonidius*; color black or dark brown; genae prominent; labrum wider than long, obtusely angulate, 4-setose; ligula narrower than usual in tribe, narrowed anteriorly, narrowly rounded at apex; length *c.* 12.5–15.0 mm.

Type. From Rockhampton, Queensland, **Australia**; present location unknown (not found at Melbourne in 1958).

Occurrence in New Guinea. **Papua**: 3, Rouku, Morehead R., Apr. 1962 (W. W. Brandt, C.S.I.R.O.); 7, Port Moresby and vicinity, various dates and collectors (Dept. Agr. Port Moresby; A.M.N.H.); 1, Bisianumu, Sogeri Subdistrict, *c.* 1600 ft. (485 m), Mar. 1955 (J. J. H. Szent-Ivany and J. McAdam, Dept. Agr. Port Moresby).

Notes. The relatively narrow ligula is diagnostic of this species in this tribe in New Guinea. I find no significant differences between specimens from Australia and from New Guinea, although individual variation occurs in both places.

Genus *HELLUODEMA* Castelnau

Castelnau 1867, Notes on Australian Coleop., p. 19.
Sloane 1914, Proc. Linnean Soc. New South Wales 39, pp. 571, 586.
Csiki 1932, Coleop. Cat., Carabidae, Harpalinae 7, p. 1581 (see for synonymy and additional references).

Diagnosis. See preceding *Key to Genera.*

Description. None required here.

Type species. Helluomorpha batesi Thomson (= *unicolor* Hope), of Australia (see below).

Generic distribution. Eastern and northern **Australia**, **New Guinea**.

Notes. Two species of this genus occur in Australia, one of them extending to New Guinea.

Helluodema unicolor (Hope)

Hope 1842, Proc. Ent. Soc. London for 1842, p. 47 (*Aenigma*).
Sloane 1914, Proc. Linnean Soc. New South Wales 39, p. 587.
Csiki 1932, Coleop. Cat., Carabidae, Harpalinae 7, p. 1581 (see for synonymy and additional references).

Description. None required here; note form (Fig. 141) slender; genae prominently rounded; prothorax only moderately (not strongly) constricted before base; labrum wider than long, obtusely angulate, 4-setose; ligula broadly rounded, obtusely emarginate at apex; length *c.* 13–15 mm.

Type. From **Australia**; present location unknown.

Occurrence in New Guinea. **Papua**: 3, Rouku, Morehead R., Apr. 1962 (W. W. Brandt, C.S.I.R.O.). **West N. G.**: 2, Merauke, sea level, Mar. 24, 28, 1955 (L. D. Brongersma, Leiden Mus.), evidently taken in light trap.

Notes. This species occurs in eastern Australia at least from northern New South Wales to Cooktown. The New Guinean specimens agree well with Australian ones.

Genus *GIGADEMA* Thomson

Thomson 1859, Arcana Naturae, p. 93.
Sloane 1914, Proc. Linnean Soc. New South Wales 39, pp. 572, 593.

Csiki 1932, Coleop. Cat., Carabidae, Harpalinae 7, p. 1582 (see for synonymy and additional references).

Diagnosis. See preceding *Key to Genera.*

Description. None required here.

Type species. G. titanum Thomson (= *nocte* Newman), of Australia.

Generic distribution. **Australia**; southern **New Guinea.**

Notes. This is the principal genus of the tribe in Australia. One of the 12 or more Australian species is now recorded from a single locality in southern New Guinea, almost opposite the tip of the Cape York Peninsula.

Gigadema maxillare Sloane

Sloane 1914, Proc. Linnean Soc. New South Wales 39, pp. 595, 599.

Description. None required here; note large size; prothorax constricted at base; color dark; surface short-pubescent; labrum *c.* long as wide, rounded, 2-setose; length of Australian specimens 27–35, of New Guinean specimen 32 mm.

Types. From tropical Queensland, **Australia**: Townsville, Kuranda, Cooktown, Princess Charlotte Bay. I here designate as lectotype a specimen labeled "Cktn., Q., Olive, ♂" and "*Gigadema maxillare* Sl., Id. by T. G. Sloane"; in Sloane Coll., C.S.I.R.O., Canberra (seen).

Occurrence in New Guinea. **Papua**: 1 ♀, Rouku, Morehead R., Apr. 1962 (W. W. Brandt, C.S.I.R.O.).

Notes. The Papuan ♀ agrees with Australian examples of *maxillare* in nonsexual characters, but a ♂ is needed to confirm the identification. Another specimen apparently of *maxillare*, but also a ♀, is before me from **Mona Is., Torres Straits** (J. W. Schomberg, S. Australian Mus.).

Tribe BRACHININI

Brachynini Csiki 1932, Coleop. Cat., Carabidae, Harpalinae 7, p. 1593 (see for synonymy and additional references).

Jedlicka 1963, Ent. Abhandlungen 28, p. 524.

Brachinidae Jeannel 1942, Faune de France, Coléop. Carabiques, Part 2, p. 1102.

——— 1949, Coléop. Carabiques de la Région Malgache, Part 3, p. 1079.

Brachininae Basilewsky 1953, Exploration Parc National l'Upemba, Fasc. 10, Carabidae, p. 235.

Habu 1967, Fauna Japonica, Carabidae, Truncatipennes Group, p. 280.

The beetles of this tribe are bombardiers (but are not the only Carabidae that "shoot" repellents) and are well known to most entomologists in most parts of the world. Their form is characteristic, and identification is confirmed by presence of 8 visible ventral abdominal segments.

Two genera of the tribe are very widely distributed, and these are the only genera that reach New Guinea. *Pheropsophus*, which occurs (discontinuously) in all principal tropical regions, has 6 New Guinean species of which 5 are endemic and 1 shared with Australia. *Brachinus*, which is almost worldwide except that it does not reach Australia, has 1 New Guinean species which is endemic but which is the easternmost member of an Oriental species group.

KEY TO GENERA OF BRACHININI OF NEW GUINEA

1. Elytra with costae strong, distinct, and separate to apex (p. 234) ..... *Pheropsophus*
– Elytra with costae weaker and becoming faint and in part vaguely connected before apex (p. 239) *Brachinus*

Genus *PHEROPSOPHUS* Solier

Solier 1833, Ann. Soc. Ent. France 2, p. 461.

Csiki 1932, Coleop. Cat., Carabidae, Harpalinae 7, p. 1595 (see for subgenera and additional references).

Parapheropsophus Hubenthal 1914, Deutsche Ent. Zeitschrift for 1914, pp. 440, 442 (new synonymy).

Csiki 1933, Coleop. Cat., Carabidae, Harpalinae 8, p. 1604 (as subgenus of *Pheropsophus*).

Diagnosis. See preceding *Key to Genera.*

Description. None required here; see Figures 147–151.

Type species. Of *Pheropsophus*, *Brachinus senegalensis* Dejean, of Africa. Of *Parapheropsophus*, *P. intermedius* Hubenthal (= *verticalis* Dejean) by present designation.

Generic distribution. All principal tropical and some warm-temperate regions of

the **world**. In the Asiatic-Australian area species are numerous in southeastern Asia and the western Malay Archipelago, fewer eastward, and only 1 variable species reaches Australia.

Notes. The supposed "subgenus" *Parapheropsophus* was based on trivial characters, primarily on the shape of the dark mark between the eyes (which is variable) supported by a supposedly characteristic habitus which, according to Hubenthal, is "leichter zu erkennenden als zu beschreibenden." In my opinion all the 4 "species" and 5 additional "varieties" listed in this subgenus by Csiki (following Hubenthal) are forms of a single species (*verticalis* Dejean) which is not worth subgeneric separation from *Pheropsophus*.

The 6 species of *Pheropsophus* that occur in New Guinea are ecologically differentiated. *P. verticalis* is very common in a variety of wet places and is winged. *P. amnicola* has been found only on the banks of large rivers (Markham and Sepik) and is always winged. The other 4 species are rare, local, flightless forms; 1 (*catulus*) is known to occur in leaf-litter on the ground in rain forest, and this is probably the habitat of the others too.

Besides the 6 species of *Pheropsophus* treated below, I have seen a single specimen of *javanus* Dejean (*agnatus* Chaudoir) labeled as from New Guinea ("New Guinea, Mimika R., A. F. R. Wollaston. 1911–229." (British Mus.)). This conspicuous species is common in the western Malay Archipelago but has not been found in New Guinea by recent collectors and has apparently not been found in the Moluccas. I think the specimen in question is probably wrongly labeled. New Guinea should be deleted from the range of the species as given by Csiki (p. 1601) and others.

KEY TO SPECIES OF *PHEROPSOPHUS* OF NEW GUINEA

1. Elytra each with 8 costae *c.* equally prominent 2
– Elytra with odd costae more prominent than even ones at least at base 5
2. Strictly bicolored: head and prothorax yellow or reddish yellow without dark marks, elytra dark without pale marks (p. 235) ..... *amnicola*
– Not thus bicolored: all or part of pronotum and part of head dark, elytra dark with or without pale marks 3
3. Front yellow with isolated usually V-shaped dark mark between eyes; inner wings large and folded (p. 236) ..... *verticalis*
– Posterior half or more of head dark; inner wings vestigial 4
4. Head bicolored, yellow anteriorly, dark posteriorly; prothorax wider than long at middle (by measurement); femora not or only minutely black-tipped; length 8.5–12.5 mm (p. 237) ..... *aptinomorphus*
– Head dark with small V-shaped reddish mark on front; prothorax as long (at middle) as wide and appearing longer; femora conspicuously black-tipped; length *c.* 18 mm (p. 237) ..... *pedes*
5. Pronotum (sparsely) punctate, much roughened at base and apex; length *c.* 15–16 mm (p. 238) ..... *catulus*
– Pronotum virtually impunctate, scarcely roughened; length 20.5 mm (p. 238) ..... *canis*

Pheropsophus amnicola n. sp.

Description. With characters of genus; form (Fig. 147) *c.* as of *verticalis*; head and pronotum yellow without dark marks, elytra black without pale marks, appendages yellow. *Head* 0.92 and 0.93 width prothorax. *Prothorax* subcordate; width/length 1.14 and 1.13; base/apex 0.94 and 1.01; sides broadly arcuate anteriorly, broadly sinuate before *c.* right posterior angles; margins very narrow; disc convex, irregularly subpunctate and punctulate. *Elytra* moderately narrowed anteriorly; width elytra/prothorax 1.64 and 1.66; each elytron with 8 well defined costae (including raised suture), the costae equally elevated and equally prominent at base; surface of costae finely microreticulate, intercostal intervals longitudinally roughened. *Inner wings* full. *Measurements*: length *c.* 8.5–15.0; width 3.2–5.3 mm.

Types. Holotype ♂ (M.C.Z., Type No. 31,525) and 34 paratypes from vic. Nadzab, **N-E. N. G.,** July 1944 (Darlington); and 1 paratype, Main R., Sepik, **N-E. N. G.,** Feb. 1965 (R. Hornabrook).

Measured specimens. The ♂ holotype and 1 ♀ paratype from Nadzab.

Notes. The preceding description contains all the characters that now seem worth specifying for this new species, which is distinguished from *verticalis* primarily by color. Color, properly understood and with allowance for variation, is in fact specific in this genus. The geographic and ecologic restriction of *amnicola*, as compared with *verticalis*, is another indication that the two species are fully distinct. My specimens were all taken on the banks of the Markham R., and none was found in any other situation.

Pheropsophus verticalis Dejean

Dejean 1825, Species Général Coléop. 1, p. 302.
Csiki 1933, Coleop. Cat., Carabidae, Harpalinae 8, p. 1604 (see for Australian "varieties" and additional references).
australis Castelnau 1867, Notes on Australian Coleop., p. 23 (new synonymy).
papuensis Macleay 1876, Proc. Linnean Soc. New South Wales 1, p. 166 (new synonymy).
Heller 1910, Abhandlungen und Berichte Zool. Mus. Dresden 13, No. 3, p. 7.
macleayi Sloane 1894, Proc. Linnean Soc. New South Wales (2) 9, p. 453 (new synonymy).
baliothorax Heller 1910, Abhandlungen und Berichte Zool. Mus. Dresden 13, No. 3, p. 6 (new synonymy).
intermedius Hubenthal 1914, Deutsche Ent. Zeitschrift for 1914, p. 440 (new synonymy).

Description. None required here. This is the only New Guinean *Pheropsophus* with an isolated black (or brown) frontal spot. See also under genus (above) and *Notes* (below); length 8.5–16.5 mm.

Types. Of *verticalis* Dejean, from "Nouvelle Hollande" (= **Australia**); in Oberthür Coll., Paris Mus. Of *australis* Castelnau, from Rockhampton, Queensland, **Australia**; present location unknown. Of *papuensis* Macleay, from Katow, **Papua**; presumably in Macleay Mus., Sydney. Of *macleayi* Sloane, from King's Sound, NW. **Australia**; lectotype not designated. Of *baliothorax* Heller, from Finschhafen, **N-E. N. G.**; in Dresden Mus. Of *intermedius* Hubenthal, from **New Britain**; in Berlin Zool. Mus. (Of all these types, I have seen only some cotypes of *macleayi*.)

Occurrence in New Guinea. Common throughout **New Guinea**: 215 specimens; most from low altitudes, only 2 individuals from above 1000 m; common at Dobodura.

Notes. The synonymy proposed above is based not on comparison of types but on examination of much material from many localities in Australia as well as New Guinea, New Britain, and some other islands. As a result of it I have concluded that, in the area in question, all the *Pheropsophus* with an isolated dark frontal spot belong to one variable species, *verticalis* Dejean, which ranges over the whole of **Australia** and **New Guinea** and extends to **New Britain**, **New Ireland**, the **Solomons**, and perhaps other islands.

In reaching this conclusion, I first considered the supposed separate northern Australian species, *macleayi* Sloane. Of it, Sloane had only 3 specimens, which happened to be rather small (11.5–13 mm) and to share some minor peculiarities of form and markings including presence of yellow shoulder spots and elytral fasciae of constant shape. My material from subtropical and tropical northern Australia shows that these characters are in fact individual rather than specific. For example, 6 specimens from the Blackall Range, in subtropical South Queensland, vary in size from 11.5 to 14.5 mm (to apex of elytra) and vary also considerably in form and somewhat in markings, although none has shoulder spots; and 4 specimens from mid-peninsular Cape York (Coen and Silver Plains) are large (*c.* 14.5–16.5 mm) and vary in exact form of prothorax, in prominence of humeri, and in markings: e.g., 2 have and 2 have not yellow shoulder spots.

The New Guinean individuals that I include in *verticalis* vary in details of form, especially in prominence of humeri. They vary in size from *c.* 8.5 to 16.5 mm. And they vary in markings: the transverse usually V-shaped dark mark between the eyes is relatively constant but is sometimes slightly extended posteriorly; the pronotum varies from wholly dark to broadly reddish yellow with only the margins dark (inter-

mediates are common); and the elytra vary from wholly dark to conspicuously marked, with median fascia often present but variable (but rarely large), shoulder spots sometimes present (distinct in only 2 individuals, from S. Highlands and Popondetta, and vestigial in a few other individuals), and apices sometimes with (variable) yellow margins. Although much of this variation is surely individual, some of it is or may be geographic. For example, New Guinean specimens usually have the elytra less heavily spotted than Australian specimens, although extremes overlap. But I think nothing is to be gained by recognizing subspecies now. The variations of this species should first be analyzed statistically, in detail, using series of specimens from exact localities, not just the New Guinean against Australian specimens. This will be third stage taxonomy (see Part I of my "Carabid Beetles of New Guinea," p. 329), far beyond what I can attempt now.

The wings of *verticalis* are fully developed, or at least large enough to be strongly folded at apex, in all my Australian specimens and all New Guinean specimens that I now assign to this species. However, occasional short-winged individuals occur that may prove to be mutants of *verticalis* although I am tentatively treating them as a separate species, *aptinomorphus* Heller (below).

P. verticalis is common in a variety of wet places. Although all individuals are winged, they may not often fly and are not often taken in light traps. Observations on their flight would be interesting.

The great variation in size of adults suggests that the larvae may be parasitoid, perhaps feeding on pupae of other beetles, as some other members of the tribe are known to do.

Pheropsophus aptinomorphus Heller

baliothorax var. *aptinomorphus* Heller 1910, Abhandlungen und Berichte Zool. Mus. Dresden 13, No. 3, p. 7.

Description. Form as in Figure 148; similar to *verticalis* (above) but elytra more narrowed to base; head bicolored, yellow anteriorly, dark posteriorly; elytra not marked (in the few specimens seen); inner wings vestigial, reduced to thin strips less than ½ long as elytra; length (to apex of elytra) *c.* 8.5–12.5 mm.

Type. From **New Guinea**, exact locality not given, but altitude stated as 120 m; in Dresden Mus. (not seen).

Occurrence in New Guinea. **N-E. N. G.**: 1, Aitape, Aug. 1944 (Darlington). **West N. G.**: 1, Waris, S. of Hollandia, 450–500 m, Aug. 16–23, 1959 (T. C. Maa, Bishop Mus.); 1, Maffin Bay, Aug. 1944 (Darlington); 1, same locality, June 15, 1944 (E. S. Ross, California Acad.).

Notes. Heller does not say whether the type is winged, but the 4 specimens listed above answer his description in color of head (which is diagnostic), and their form, with narrowed humeri, does recall *Aptinus*.

If it were not for the different head marking, I would consider my specimens of *aptinomorphus* to be short-winged mutants of *verticalis*. The distribution of the short-winged individuals, widely scattered and occurring with *verticalis* (which I have from Waris and Maffin Bay and which probably occurs at Aitape too), would be consistent with their being mutants. But if they are mutants, then the mutant gene apparently must modify color of head as well as length of wings and form of elytra, and I do not dare assume that this is the case without further evidence.

Pheropsophus pedes n. sp.

Description. With characters of genus; form as in Figure 149, with relatively long narrow prothorax and elytra ample but strongly narrowed to base; black, head with irregular red marks including U-shaped mark between eyes, appendages reddish, femora broadly tipped with black. *Head* 0.96 width prothorax; eyes normal; 1st antennal segments swollen; labrum semicircular; front 2-impressed anteriorly, with surface finely *c.* isodiametrically reticulate.

Prothorax long; width length 1.01; base apex 1.06; margins narrow, each with 1 principal seta behind middle of length; disc moderately convex, with scattered punctures (the punctures with setae as usual in genus), strongly roughened at base, less so apically, and with disc finely irregularly microreticulate. *Elytra*: width elytra/prothorax 1.95; each elytron with 8 costae (including raised suture) *c.* equally developed; surface of costae finely irregularly microreticulate, intercostal intervals longitudinally roughened. *Inner wings* evidently atrophied. *Measurements*: length 18; width 6.5 mm.

Type. Holotype ♀ (Bishop Mus.) from Bomberi, Vogelkop, **West N. G.,** 700–900 m, June 7, 1959 (T. C. Maa); the type is unique.

Notes. I do not know the relationships of this obviously distinct species. Characters distinguishing it from other New Guinean *Pheropsophus* are given in the preceding *Key to Species.*

Pheropsophus catulus n. sp.

Description. With characters of genus; form as in Figure 150, with elytra strongly narrowed to base; brownish black, head variably red-marked anteriorly, appendages reddish. *Head* 0.91 and 0.90 width prothorax; eyes moderate; 1st antennal segments slightly swollen; labrum transverse, slightly prominent at middle; front 2-impressed anteriorly, with surface finely irregularly microreticulate, roughened posteriorly. *Prothorax* quadrate-subcordate; width/length 1.01 and 1.07; base/apex 1.11 and 1.13; sides weakly arcuate anteriorly, broadly sinuate before basal angles; latter acute except blunted, slightly produced posteriorly; margins moderate, each with one principal seta behind middle of length; disc irregularly convex, irregularly roughened especially posteriorly and anteriorly, and surface also with scattered punctures (with hairs as usual) and irregularly faintly microreticulate. *Elytra*: width elytra/prothorax 1.72 and 1.74; each elytron with 8 costae (including raised suture), even costae stronger than odd ones and reaching base; surface of costae faintly finely microreticulate, intercostal intervals finely longitudinally roughened, and alternate intervals each with row of widely spaced setae. *Inner wings* reduced to vestiges that hardly extend beyond edge of metathorax. *Measurements*: length *c.* 15–16; width 5.0–5.6 mm.

Types. Holotype ♂ (M.C.Z., Type No. 31,526) and 2 ♀ ♀ paratypes all from Dobodura, **Papua**, Mar.–July 1944 (Darlington).

Measured specimens. The ♂ holotype and 1 ♀ paratype.

Notes. I do not know the relationships of this very distinct species, which is quite different from any of the preceding ones although closely related to the following (*canis*). The beetles were taken among dead leaves on the ground in rain forest.

Pheropsophus canis n. sp.

Description. With characters of genus; form as in Figure 151, with elytra strongly narrowed to base; brownish black, head red anteriorly dark posteriorly, pronotum with faint reddish marks, legs reddish yellow, antennae brown. *Head* 0.87 width prothorax; eyes moderate; 1st antennal segments slightly swollen; labrum transverse, with margin broadly rounded; front weakly 2-impressed, closely irregularly microreticulate, roughened posteriorly. *Prothorax* narrowly subcordate; width/length 1.07; base/apex 1.06; sides broadly arcuate anteriorly, broadly sinuate before slightly obtuse, slightly blunted, posterior angles; latter not produced posteriorly; margins moderate, each with 1 principal seta behind middle; disc moderately convex, weakly roughened posteriorly but otherwise nearly smooth, surface with fine irregular reticulate microsculpture. *Elytra*: width elytra prothorax 1.80; each elytron with 5 conspicuous costae (nos. 1, 3, 5, 7, 8), the intermediate costae (nos. 2, 4, 6) weak or obsolete; surface of costae finely irregularly microreticulate, in-

tercostal intervals finely roughened; even intervals probably with widely spaced setae, but latter in part broken off or missing. *Inner wings* evidently vestigial. *Measurements*: length *c.* 20.5; width 7.6 mm.

Type. Holotype ♀ (Hawaiian Sugar Planters Association) from Koitaki, **Papua**, 1500 ft. (*c.* 460 m), Nov.–Dec. 1928 (Pemberton Coll.); the type is unique.

Notes. This flightless species is probably a geographic representative of the preceding (*catulus*) but is larger, slightly different in proportions, with antennae darker, pronotum much less roughened, and even intervals of elytra much more reduced. Other, related forms of this flightless group are to be expected elsewhere in New Guinea.

Genus *BRACHINUS* Weber

Weber 1801, Observationes Entomologicae, p. 22.
Brachynus Auct. including Csiki 1933, Coleop. Cat., Carabidae, Harpalinae 8, p. 1606 (see for additional references).

Diagnosis. See preceding *Key to Genera.*

Description. None required here.

Type species. Carabus crepitans Linnaeus, of Europe.

Generic distribution. Most of the **world**, except Australia. In the Indo-Australian area, many diverse species occur in India, etc.; fewer, in the western part of the Malay Archipelago; and a single species occurs in New Guinea.

Brachinus papua n. sp.

Description. Form as in Figure 152; dark brown or brownish black, head red anteriorly or with 2 red spots between eyes, pronotum sometimes vaguely reddish, appendages reddish with tibiae, tarsi, and apices of femora darker brown; dull, entire upper surface with fine, *c.* isodiametric but irregular reticulate microsculpture, and much of upper surface with inconspicuous fine pubescence, often in part rubbed away, and perhaps missing on front, part of prothoracic disc, and disc of elytra. *Head* 1.01 and 0.99 width prothorax; eyes moderate, genae oblique, setose; front longitudinally impressed each side, nearly smooth or slightly roughened and punctulate (variable), with head more roughened posteriorly. *Prothorax* subcordate (exact form variable); width/length 1.07 and 1.07; base/apex 1.03 and 1.01; margins moderate, each with apparently 1 principal seta near middle of length; disc weakly convex, slightly finely transversely wrinkled, irregularly punctulate, slightly longitudinally roughened at base and apex. *Elytra* ample; width elytra/prothorax 2.34 and 2.33; intervals slightly raised but not costate. *Inner wings* full. *Measurements*: length 17.5–19.0; width 7.3–8.0 mm.

Types. Holotype ♂ (M.C.Z., Type No. 31,527) from Hollandia, **West N. G.,** 250 ft., May 1945 (H. Hoogstraal); 1 paratype, same locality, Apr. 1945 (B. Malkin, U.S.N.M.); 2 paratypes, Tanahmerah, Res. Boven Digoel, **West N. G.,** Feb. 1958 (R. T. Simon Thomas); and 1 paratype, Fenichel (Hungarian National Mus.).

Measured specimens. The ♂ holotype and 1 ♀ paratype from Tanahmerah.

Notes. This, the first known New Guinean *Brachinus*, may represent *bigutticeps* Chaudoir of Java, etc., but *papua* is larger than my specimens of *bigutticeps*, with less sharply bicolored legs and less roughened pronotum. Further study is needed to clarify the relationships of these and related species in the Malay Archipelago.

Tribe PSEUDOMORPHINI

Csiki 1933, Coleop. Cat., Carabidae, Harpalinae 8, p. 1634 (see for synonymy and additional references).
Pseudomorphidae Auct. including Notman 1925, Proc. United States National Mus. 67, Art. 14, p. 1.

Pseudomorphini (Figs. 153–159) do not look like Carabidae but superficially resemble dytiscids or scolytids or *Cryptocephalus*-like chrysomelids. They are numerous only in Australia; a few small species occur in New Guinea; a species of

the Australian and New Guinean genus *Adelotopus* has been found in Java; one genus, *Cryptocephalomorpha*, ranges from New Guinea across the Malay Archipelago to the SE. corner of Asia; and a supposed endemic genus is localized on New Caledonia. Outside this area the tribe contains only a single genus, *Pseudomorpha*, confined to the Americas and ranging from southern United States to Brazil and Argentina.[4]

Although I have only 15 specimens of this tribe from New Guinea, they include 3 genera and 7 species, and all the species are different from the single pseudomorphine (*Adelotopus papuanus*) previously known from the island. (An "*Adelotopus sp.*" listed from New Guinea by Heller, in Abhandlungen und Berichte Zool. Mus. Dresden 13, 1910, No. 3, p. 4, has not been identified.) Because my material is very limited and because the species are well defined by easily seen characters, I shall treat the members of this tribe rather superficially, leaving dissection of the mouthparts, etc., to the next reviser of the tribe as a whole. Notman's (1925) keys to the Australian species of this tribe are very useful but, because they are based largely on old descriptions rather than on specimens, they should be used with caution.

Most Australian Pseudomorphini live on the trunks of trees, especially on the shaggy trunks of *Eucalyptus*. They are very active, winged beetles. I do not know the habits of the New Guinean forms.

[4] The following notes are necessary to justify my summary of the distribution of this zoogeographically interesting tribe. The African *Hydroporomorpha* has only 4 entire ventral abdominal segments; it is not a pseudomorphine but probably a harpaline. *Paussotropus* is Australian and probably does not occur on Batchian Is. (Notman 1925, p. 5, footnote; confirmed by me at the British Mus. in 1948). And *Silphomorpha amaroides* (Newman), listed from Oceania by Csiki (1933, p. 1639), is probably really Australian; Newman gives no locality except "Its habitat is 3753," but he refers to the insect as "this pretty antipodean."

Key to Genera of Pseudomorphini of New Guinea

1. Eyes superior in position, not interrupting lateral margins of head (p. 240) *Adelotopus*
– Eyes lateral in position, broadly interrupting lateral margins of head ... 2
2. Form wider, more depressed; head not strongly deflexed, labrum and mandibles visible from in front (p. 242) ... *Sphallomorpha*
– Form subcylindric; head strongly deflexed, labrum and mandibles (except sometimes their tips) not visible from in front (p. 242) *Cryptocephalomorpha*

Genus *ADELOTOPUS* Hope

Hope 1834, Trans. Ent. Soc. London 1, p. 11.
Notman 1925, Proc. United States National Mus. 67, Art. 14, pp. 5, 6.
Csiki 1933, Coleop. Cat., Carabidae, Harpalinae 8, p. 1634 (see for additional references).

Diagnosis. See preceding *Key to Genera.*

Description. None required here.

Type species. *A. gyrinoides* Hope, of Australia.

Generic distribution. **Australia** including **Tasmania** (many species), **New Guinea** (4 species), and **Java** (1 species).

Notes. *A. jacobsoni* Ritsema (1909, Notes Leiden Mus. 31, p. 255) of Java evidently really is an *Adelotopus*, not a *Cryptocephalomorpha*, for Ritsema knew both genera.

Key to Species of *Adelotopus* of New Guinea

1. Piceous, with narrow reddish translucent margins but otherwise unmarked; length 6.6–7.0 mm (p. 240) *exactor*
– Black, elytra marked or tipped with red or yellow; smaller ... 2
2. Elytra with red apices (p. 241) ... *debitor*
– Elytra with yellow or reddish marks near base ... 3
3. Elytra with wide basal fascia rufo-testaceous; scutellum yellow-margined (p. 241) *papuanus*
– Elytra each with large subbasal yellow spot; scutellum not yellow-margined (p. 241) *bijugus*

Adelotopus exactor n. sp.

Description. With characters of genus; form as in Figure 153, moderately convex; piceous, unmarked except prothorax and elytra narrowly reddish translucent at sides, lower surface red; no dorsal pubescence or

setae except on humeral margins; not shining, entire upper surface with fine *c.* isodiametric to slightly transverse microsculpture and very fine well spaced punctulation. *Head* 0.54 width prothorax. *Prothorax*: width/length 1.98; base/apex 1.84; margins moderate, moderately reflexed. *Elytra*: width elytra/prothorax 1.07; basal marginal line sharply impressed, nearly entire, not punctate; posthumeral impressions weak; margins moderate; striae not indicated. *Measurements*: length 6.6–7.0; width 3.5–3.7 mm.

Types. Holotype, sex not determined (S. Australian Mus.) and 1 paratype (M.C.Z., Type No. 31,528) both from Wareo, Finschhafen ("Finsch Haven"), **N-E. N. G.** (Rev. L. Wagner).

Measured specimen. The holotype. The paratype has the pronotum broken and cannot be satisfactorily measured.

Notes. In Notman's (1925) key to Australian *Adelotopus* this runs to *hydrobioides* Westwood, but comparison with Australian specimens identified as *hydrobioides* shows that *exactor* is narrower, with narrower prothoracic and elytral margins.

Adelotopus debitor n. sp.

Description. With characters of genus; form as in Figure 154, very convex especially elytra; black, apical ⅓ of elytra red, lower surface black anteriorly, red posteriorly, appendages red; no dorsal pubescence or setae except on humeral margins; shining, fine isodiametric microsculpture distinct on head, indistinct on pronotum, absent on elytra, but whole upper surface with fine moderately spaced punctulation. *Head* 0.54 width prothorax. *Prothorax*: width/length 2.18; base/apex 1.76; margins moderate, poorly defined, moderately reflexed especially anteriorly. *Elytra*: width elytra/prothorax 1.04; basal margin irregular or obsolete on *c.* inner ½ of width of elytron; sides scarcely impressed behind humeri; margins moderate; striae not indicated. *Measurements*: length 5.5; width 2.8 mm.

Types. Holotype, sex not determined (Bishop Mus.), from Wau, Morobe Dist., **N-E. N. G.,** 1200 m, Jan. 16, 1961 (Sedlaceks); 1 paratype (M.C.Z., Type No. 31,590), Kokoda-Pitoki, **Papua**, 450 m, Mar. 24, 1956 (Gressitt).

Notes. In Notman's (1925) key to the Australian species of *Adelotopus*, this runs to *apicalis* Macleay or possibly *haemorrhoidalis* Erichson, but comparison with Australian specimens of these species shows that *debitor* is broader anteriorly and more narrowed posteriorly.

Adelotopus papuanus Gestro

Gestro 1893, Ann. Mus. Civ. Genoa 33, p. 287. Notman 1925, Proc. United States National Mus. 67, Art. 14, p. 8.

Description (significant details from Gestro). Form perhaps similar to other New Guinean species of genus; black, prothorax with reddish margins, elytra with wide basal fascia reddish testaceous and scutellum with testaceous margin; shining, very finely punctulate; length 4.75 mm.

Type. From "Ighibirei, lungo il Kemp Welch"; in Genoa Mus. (not seen).

Notes. This species seems surely different from any New Guinean *Adelotopus* I have seen. Gestro compared it only with *A. bimaculatus* Macleay of Australia.

Adelotopus bijugus n. sp.

Description. With characters of genus; form as in Figure 155, very convex; black, elytra each with large yellowish plagia before middle, lower surface mainly dark, some ventral segments narrowly yellow at apex, appendages rather dark; no dorsal pubescence or setae except on humeral margins; shining, reticulate microsculpture faint or absent but whole upper surface rather closely conspicuously punctulate. *Head* 0.55 and 0.57 width prothorax. *Prothorax*: width/length 1.72 and 1.84; base/apex 1.71 and 1.60; margins moderate, well reflexed, not sharply defined inwardly. *Elytra*: width elytra/prothorax 1.01 and 1.02; basal margin irregular or obsolete in inner ½ of width of elytron; sides slightly

impressed behind humeri; margins moderate anteriorly, obsolete posteriorly; striae not indicated on elytral surface but vaguely suggested under the surface in the pale areas. *Measurements*: length 4.4–5.2; width 2.2–2.5 mm.

Types. Holotype, sex not determined (Bishop Mus.), from Wau, Morobe Dist., **N-E. N. G.,** 1200 m, May 25, 1962 (Sedlacek), and paratypes as follows: 1, Wau, 1200 m, Dec. 1, 1961; 1, Wau, 1200 m, Dec. 18, 1961; 1, Wau, 1250 m, Mar. 27, 1964; 1, Mt. Missim (near Wau), 980–1100 m, Aug. 14, 1964; all specimens collected by the Sedlaceks; 2 paratypes now in M.C.Z. (Type No. 31,529).

Notes. In Notman's (1925) key to the Australian species of *Adelotopus*, this runs to *bimaculatus* Macleay but has wider prothoracic and elytral margins than my Australian *bimaculatus*.

Genus *CRYPTOCEPHALOMORPHA* Ritsema

Ritsema 1875, Tijdschrift voor Ent. 18, Verslag, p. XCII.
Notman 1925, Proc. United States National Mus. 67, Art. 14, pp. 5, 12.

Diagnosis. See preceding *Key to Genera.*
Description. None required here.
Type species. C. gaverei Ritsema, of Java, etc.
Generic distribution. Previously known from **Thailand**, **Sumatra**, **Java**, **Borneo** (British Mus.), and **Philippines** (Luzon, in M.C.Z.); now recorded from **New Guinea**.

Notes. This genus of very small scolytid-like Pseudomorphini is the only genus of the tribe known to be widely distributed in the Malay Archipelago and the only genus known to reach the Asiatic mainland.

Cryptocephalomorpha papua n. sp.

Description. With characters of genus; form as in Figure 156, subcylindric; entirely slightly irregular reddish brown; no dorsal pubescence or setae; reticulate microsculpture indistinct or absent but whole upper surface with fine moderately spaced punctulation. *Head* 0.72 and 0.71 width prothorax. *Prothorax*: width/length 1.41 and 1.49; base/apex 1.37 and 1.41; margins very narrow. *Elytra*: width elytra/prothorax 1.00 and 1.00; basal margin apparently absent (possibly hidden by base of prothorax); side margins very narrow; striae not indicated. *Measurements*: length 3.0–3.3; width 1.4–1.5 mm.

Types. Holotype, sex not determined (British Mus.) and 1 paratype (M.C.Z., Type No. 31,530) both from Kokoda, **Papua**, 1200 ft. (*c.* 370 m), Sept. (holotype) and June (paratype) 1933 (Cheesman), the paratype taken at light.

Notes. The plain, unspotted coloration distinguishes this from the 2 previously known species of the genus, *gaverei* Ritsema and *collaris* Waterhouse, both of which occur farther west in the Malay Archipelago.

Genus *SPHALLOMORPHA* Westwood

Westwood 1841, Trans. Linnean Soc. London 18, p. 414.
Notman 1925, Proc. United States National Mus. 67, Art. 14, pp. 6, 25.
Csiki 1933, Coleop. Cat., Carabidae, Harpalinae 8, p. 1641 (see for additional references).

Diagnosis. See preceding *Key to Genera.*
Description. None required here.
Type species. S. decipiens Westwood, of Australia.
Generic distribution. **Australia** (many species) and **New Guinea** (3 species).

Notes. The following 3 species, like other members of the tribe in New Guinea, are probably not directly related among themselves but are all independently related to Australian species.

KEY TO SPECIES OF *SPHALLOMORPHA* OF NEW GUINEA

1. Color pattern 4-maculate (elytra each with 2 large yellow spots) (p. 243) *quadrua*
– Color pattern not 4-maculate 2
2. Elytra each with a large, irregular yellow plagia (p. 243) *dupla*
Elytra with a common heart-shaped yellow plagia (p. 243) *unita*

Sphallomorpha quadrua n. sp.

Description. With characters of genus; form as in Figure 157, moderately convex; brownish black, margins of prothorax and elytra paler, elytra each with 2 large pale yellow spots as indicated (Fig. 157), below reddish with head darker, appendages reddish; no dorsal pubescence or setae except setae at humeral angles and at posterior angles of head; dull, entire upper surface isodiametrically to irregularly microreticulate and finely punctulate. *Head* 0.63 width prothorax. *Prothorax*: width/length 2.50; base/apex 1.51; margins narrowly slightly reflexed. *Elytra*: width elytra/prothorax 1.10; base not margined; sides scarcely impressed behind humeri; margins not strongly reflexed; striae not indicated. *Measurements*: length 5.7; width 3.0 mm.

Type. Holotype, sex not determined (Chicago Mus.), from Gadaisu, **Papua**, Nov. 15, 1917 (J. T. Zimmer); the type is unique.

Notes. In Notman's (1925) key to Australian members of this genus, *quadrua* runs to *quadrimaculata* Macleay, but *quadrua* is dull, while the description of *quadrimaculata* calls for a "brilliant shining black" insect.

The unique type of *quadrua* was probably taken in a light trap, for many insect scales are stuck to its surface.

Sphallomorpha dupla n. sp.

Description. With characters of genus; form as in Figure 158, moderately convex; black, lateral and basal margins of prothorax and lateral margins of elytra slightly rufescent, elytra each with large yellow plagia as indicated (Fig. 158), lower surface and appendages reddish or yellow; no dorsal pubescence or setae except setae at humeral angles and posterior angles of head; head and pronotum dull, elytra more shining, entire upper surface with fine *c.* isodiametric microsculpture and faint fine punctulation. *Head* 0.58 width prothorax. *Prothorax*: width/length 2.32; margins poorly defined, weakly reflexed. *Elytra*: width elytra/prothorax 1.10; base not margined; sides scarcely impressed behind humeri; margins narrowly reflexed; striae not indicated on surface. *Measurements*: length 5.8; width 3.2 mm.

Type. Holotype, sex not determined (Bishop Mus.), from Wau, Morobe Dist., **N-E. N. G.,** 1500 m, June 15, 1962 (Sedlaceks); the type is unique.

Notes. The color pattern of *dupla* is somewhat like that of *colymbetoides* Westwood and *bimaculata* Castelnau, but *dupla* is much smaller than either of these Australian species.

The type of this species too has insect scales stuck to it and was probably taken in a light trap.

Sphallomorpha unita n. sp.

Description. With characters of genus; form as in Figure 159, moderately convex; without pubescence or setae above, except setae behind eyes; piceous black, margins faintly paler, elytra with large common plagia as indicated (Fig. 159), lower surface and appendages irregular dark reddish; no pubescence or setae above except setae at posterior angles of head (apparently not at humeral angles); moderately shining, but whole upper surface isodiametrically to irregularly reticulate (finely) and just visibly punctulate. *Head* 0.54 width prothorax. *Prothorax*: width/length 2.47; base/apex 1.72; sides narrowly moderately reflexed. *Elytra*: width elytra/prothorax 1.08; base not margined; sides slightly impressed behind humeri; margins narrowly reflexed; striae faintly indicated especially in pale area. *Measurements*: length 5.1; width 3.0 mm.

Type. Holotype, sex not determined (British Mus.), from Mafulu, **Papua**, 4000 ft. (1220 m), Jan. 1934 (Cheesman); the type is unique.

Notes. The marking of *unita* is probably like that of *cordifer* Blackburn, of North Queensland, Australia, but *cordifer* is *c.* 8 mm long, against *c.* 5 mm for *unita.*

(Received 23 March 1967.)

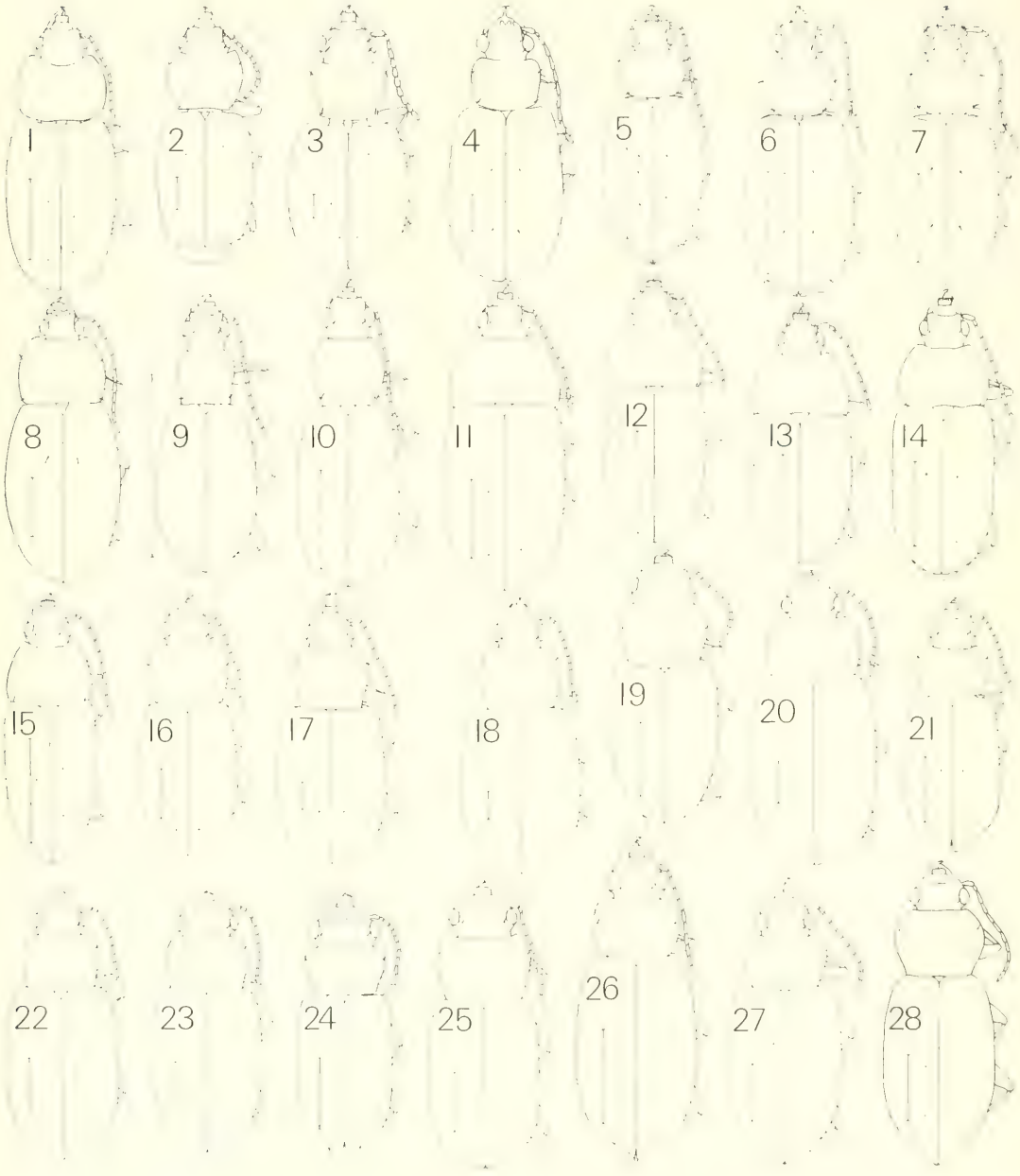

Fig. **1**, *Perigona rex* n. sp., ♂ holotype; **2**, *P. rossi* n. sp., holo.; **3**, *P. dentifer* n. sp., holo.; **4**, *Physolaethus caviceps* Andrewes, ♂ Enarotadi; **5**, *Omestes torta* Andrewes, ♀ Hollandia; **6**, *Dicrochile acuta* n. sp., ♂ holo.; **7**, *D. alternans* n. sp., ♂ paratype, Chimbu Vy.; **8**, *Microferonia baro* n. sp., ♂ holo.; **9**, *Chlaenius pan* n. sp., ♀ para., Kota Nika; **10**, *C. olthofi* n. sp., ♀ para., Bernhard Camp; **11**, *Oodes nil* n. sp., ♀ holo.; **12**, *O. rossi* n. sp., ♂ holo.; **13**, *O. wilsoni* n. sp., ♀ holo.; **14**, *O. par* n. sp., ♂ holo.; **15**, *O. longior* n. sp., ♂ holo.; **16**, *Diaphoromerus papuellus* n. sp., ♀ para., Kokoda; **17**, *Lecanomerus angustior* n. sp., ♀ para., Hollandia; **18**, *L. latior* n. sp., ♂ holo.; **19**, *Chydaeus papua* n. sp., ♀ para., Mt. Wilhelm; **20**, *Trichotichnus straneoi* (Louwerens), ♀, Hollandia; **21**, *T. modus* n. sp., ♂ holo.; **22**, *T. mongi* n. sp., ♀ holo.; **23**, *T. delicatus* n. sp., ♀ para., I. Deslacs; **24**, *Harpaloxenus fortis* n. sp., ♀ para., Dobodura; **25**, *Lyter glaber* n. gen. & sp., ♂ para., Finschhafen; **26**, *Coleolissus papua* n. sp., ♀ para., Hollandia area; **27**, *C. angulatus* n. sp., ♀ para., Dobodura; **28**, *Hyphaereon levis* n. sp., ♀ para. Sibil.

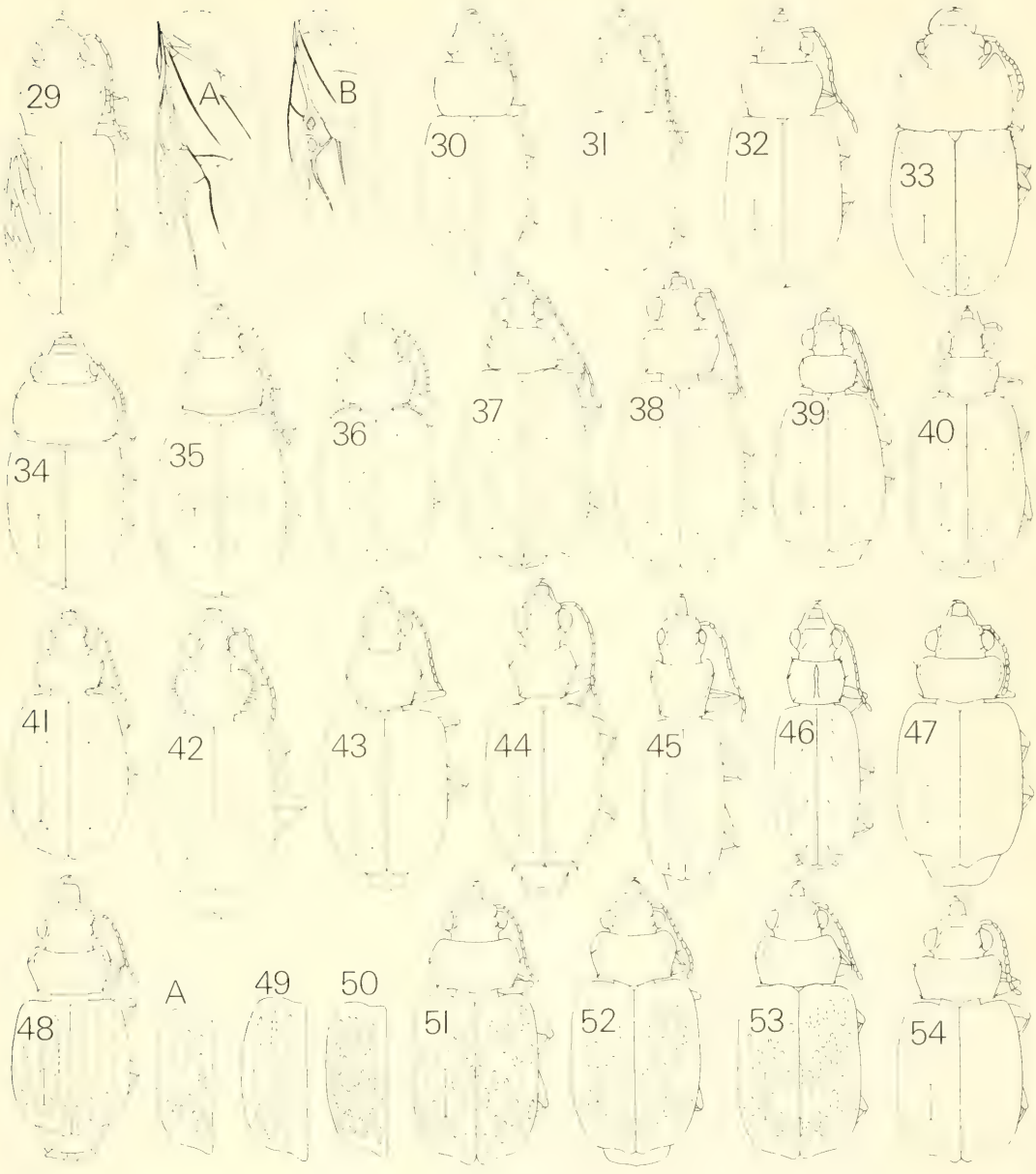

Fig. **29**, *Hyphaereon timidus* n. sp., ♂ paratype, Dobodura; **29A**, same, wing to same scale, ♀ para., Dobodura; **29B**, same, wing to same scale, another ♀ para., Dobodura; **30**, *Egadroma cyclops* n. sp., ♀ holotype; **31**, *Acupalpus exactus* n. sp., ♀ holo.; **32**, *A. papua* n. sp., ♀ para., Dobodura; **33**, *Odontomasoreus humeralis* n. gen. & sp., ♀ para., Dobodura; **34**, *Anaulacus siamensis* Chaudoir, ♂ Geelvink Bay; **35**, *Sarothrocrepis papua* n. sp., ♂ para., Dobodura; **36**, *Somotrichus elevatus* (Fabricius), ♀ Peleliu Is.; **37**, *Aristolebia papua* n. sp., ♀ para., Wau; **38**, *Lebia endynomena* n. sp., ♂ holo.; **39**, *L. externa* n. sp., ♂ holo.; **40**, *L. cordifer* n. sp., ♂ holo.; **41**, *L. insularum* n. sp., ♂ holo.; **42**, *Lachnoderma foveolatum* Sloane, ♀ Goilala; **43**, *Sinurus opacus* Chaudoir, ♂ Waigeu Is.; **44**, *Stenotelus spinosus* n. sp., ♀ para., Dobodura; **45**, *Miscelus sibling* n. sp., ♀ para., Dobodura; **46**, *Holcoderus elongatus* (Saunders), ♀ Wau; **47**, *Minuthodes metallica* n. sp., ♂ holo.; **48**, *M. papuana* (Sloane), ♂ Dobodura; **48A**, same, another ♂, Dobodura; **49**, *M. lineella* (Chaudoir), ♀ Morotai Is.; **50**, *M. queenslandica* (Sloane), ♂ Rocky Scrub; **51**, *M. rossi* n. sp., ♂ holo.; **52**, *M. sedlacekorum* n. sp., ♂ holo.; **53**, *M. subnitens* n. sp., ♂ holo.; **54**, *M. simplex* n. sp., ♀ holo.

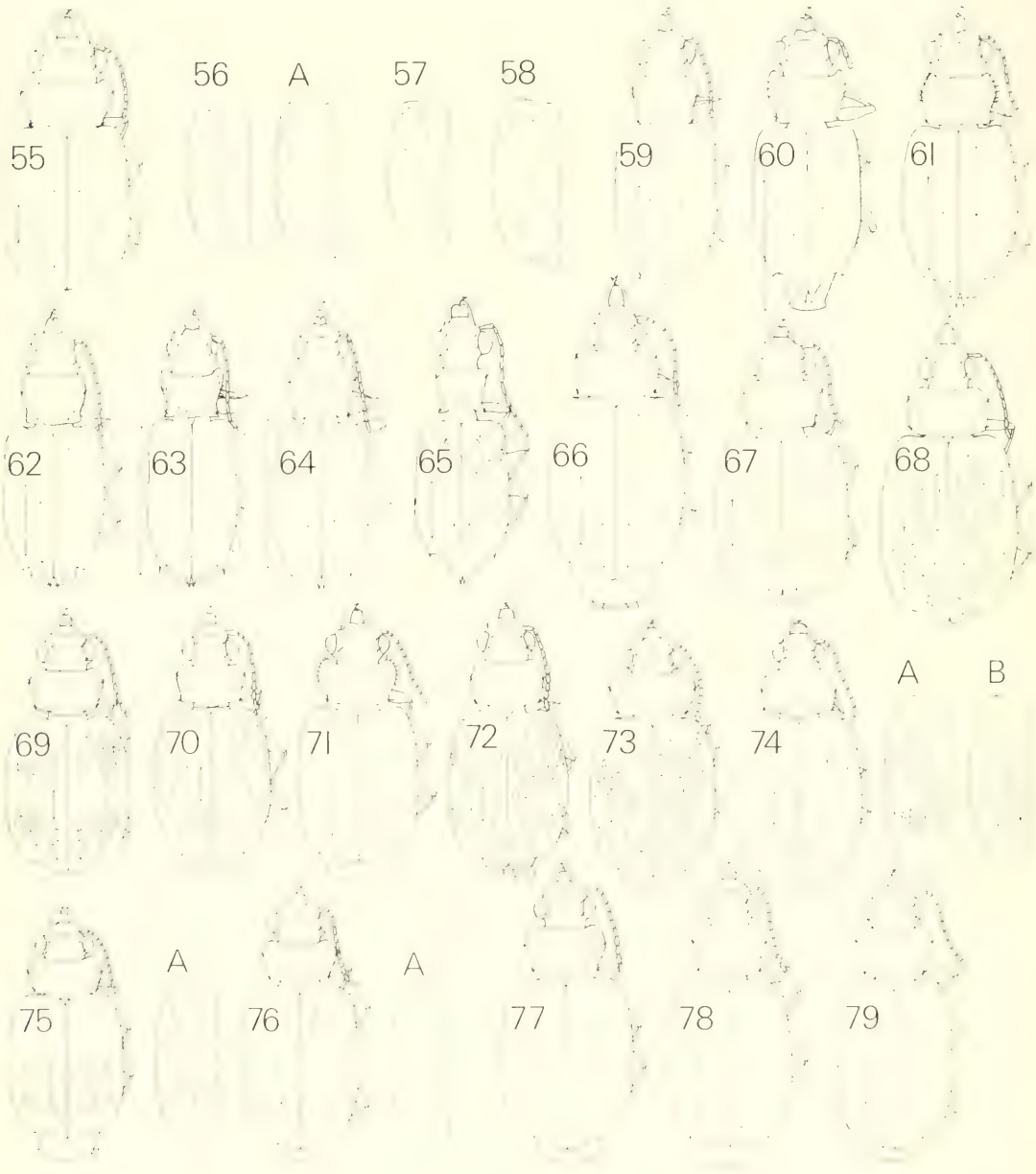

Fig. **55**, *Minuthodes sexualis* n. sp., ♀ holotype; **56**, *M. s. signata* n. subsp., ♂ paratype, Sambeang; **56A**, same, ♂, Wau; **57**, *M. regularis* n. sp., ♂ para., Dobodura; **58**, *M. irregularis* n. sp., ♂ para., Hollandia; **59**, *Catascopus brunneus* n. sp., ♂ holo.; **60**, *C. latus* n. sp., ♀ holo.; **61**, *C. sidus* n. sp., ♂, Sibil; **62**, *C. dobodura* n. sp., ♀, Kiunga; **63**, *C. taylori* n. sp., ♀ para., Mt. Missim; **64**, *C. rex* n. sp., ♂ para., Kiunga; **65**, *Pericalus figuratus* Chaudoir, ♂, Dobodura; **66**, *Coptodera grossa* n. sp., ♀ holo.; **67**, *C. ornatipennis* Louwerens, ♂, Dobodura; **68**, *C. lineolata* Bates, ♀, Oro Bay; **69**, *C. papuella* n. sp., ♂ holo.; **70**, *C. wau* n. sp., ♂ para., Wau; **71**, *Minuphloeus mixtus* n. gen. & sp., ♀ para., Wau; **72**, *Agonochila minuthoides* n. sp., ♂ holo.; **73**, *A. duplicata* n. sp., ♂ holo.; **74**, *A. variabilis* n. sp., ♀ para., Wagete; **74A**, same, ♂ holo.; **74B**, same, ♂ para., Wau; **75**, *A. expansa* n. sp., ♀ holo.; **75A**, same, ♂ para., Mt. Hagen; **76**, *A. dorsata* n. sp., ♂ holo.; **76A**, same, ♀, Edie Ck.; **77**, *Oxyodontus tripunctatus* Chaudoir, ♀, Dobodura; **78**, *Mochtheros obscurus* (Sloane), ♀, Dobodura; **79**, *Mochtheroides niger* Jedlicka, ♂, Cape Gloucester.

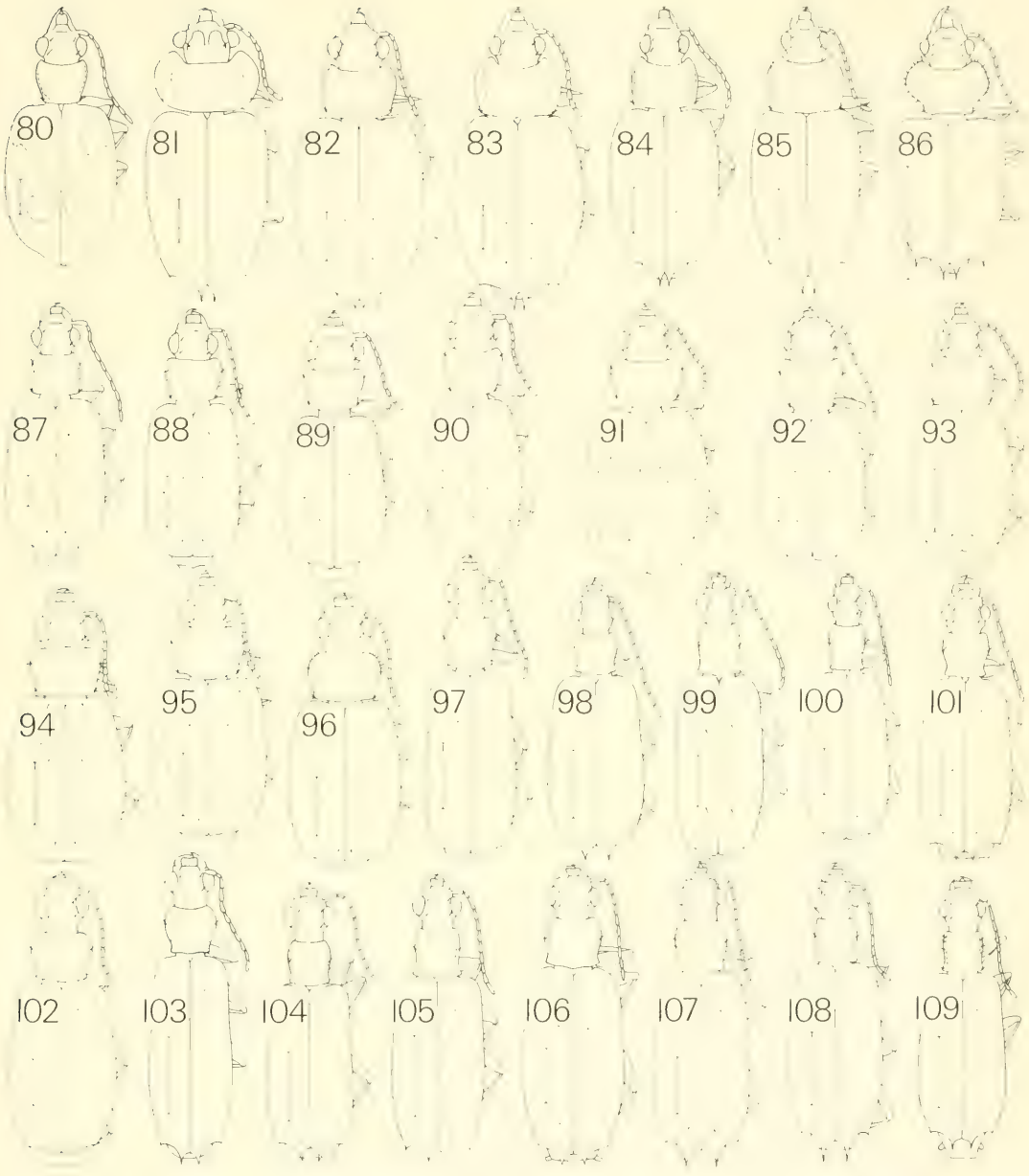

Fig. **80**, *Dolichoctis microdera* Andrewes, ♂, Dobodura; **81**, *D. distorta* n. sp., ♂ paratype, Kokoda; **82**, *D. dentata* n. sp., ♀ para., Dobodura; **83**, *D. subrotunda* n. sp., ♂ holotype; **84**, *D. subquadrata* n. sp., ♂ holo.; **85**, *D. divisa* n. sp., ♂ holo.; **86**, *Stricklandia lata* n. sp., ♀ para., Wagete; **87**, *Peliocypas papua* n. sp., ♂ para., Madang; **88**, *Celaenephes parallelus* Schmidt-Goebel, ♀, Dobodura; **89**, *Syntomus quadripunctatus* (Schmidt-Goebel), ♂ Wau; **90**, *Microlestes curtatus* n. sp., ♀ para., Luzon; **91**, *M. cinctus* n. sp., ♂ holo.; **92**, *Apristus biroi* n. sp., ♀ para., Madang; **93**, *Plochionus pallens* (Fabricius), ♀, Java; **94**, *Parena fasciata* (Chaudoir), ♀, Mumeng; **95**, *Anchista binotata* (Dejean), ♀, Hagita; **96**, *Endynomena pradieri* (Fairmaire), ♀, Samoa; **97**, *Demetrida goroka* n. sp., ♀ holo.; **98**, *D. tesselata* n. sp., ♀ holo.; **99**, *D. subtenuis* n. sp., ♂ holo.; **100**, *D. tenuis* n. sp., ♀ holo.; **101**, *D. genicula* n. sp., ♀ para., Wau; **102**, *D. latangula* n. sp., ♀ para., Brown R.; **103**, *D. kokoda* n. sp., ♀ para., Kokoda; **104**, *D. forma* n. sp., ♀ para., Pindiu; **105**, *D. rex* n. sp., ♂ para., Pindiu; **106**, *D. nigripes* n. sp., ♂ holo.; **107**, *D. vigil* n. sp., ♂ holo.; **108**, *D. nigriceps* n. sp., ♂ holo.; **109**, *D. seticollis* n. sp., ♀ para., Enarotadi.

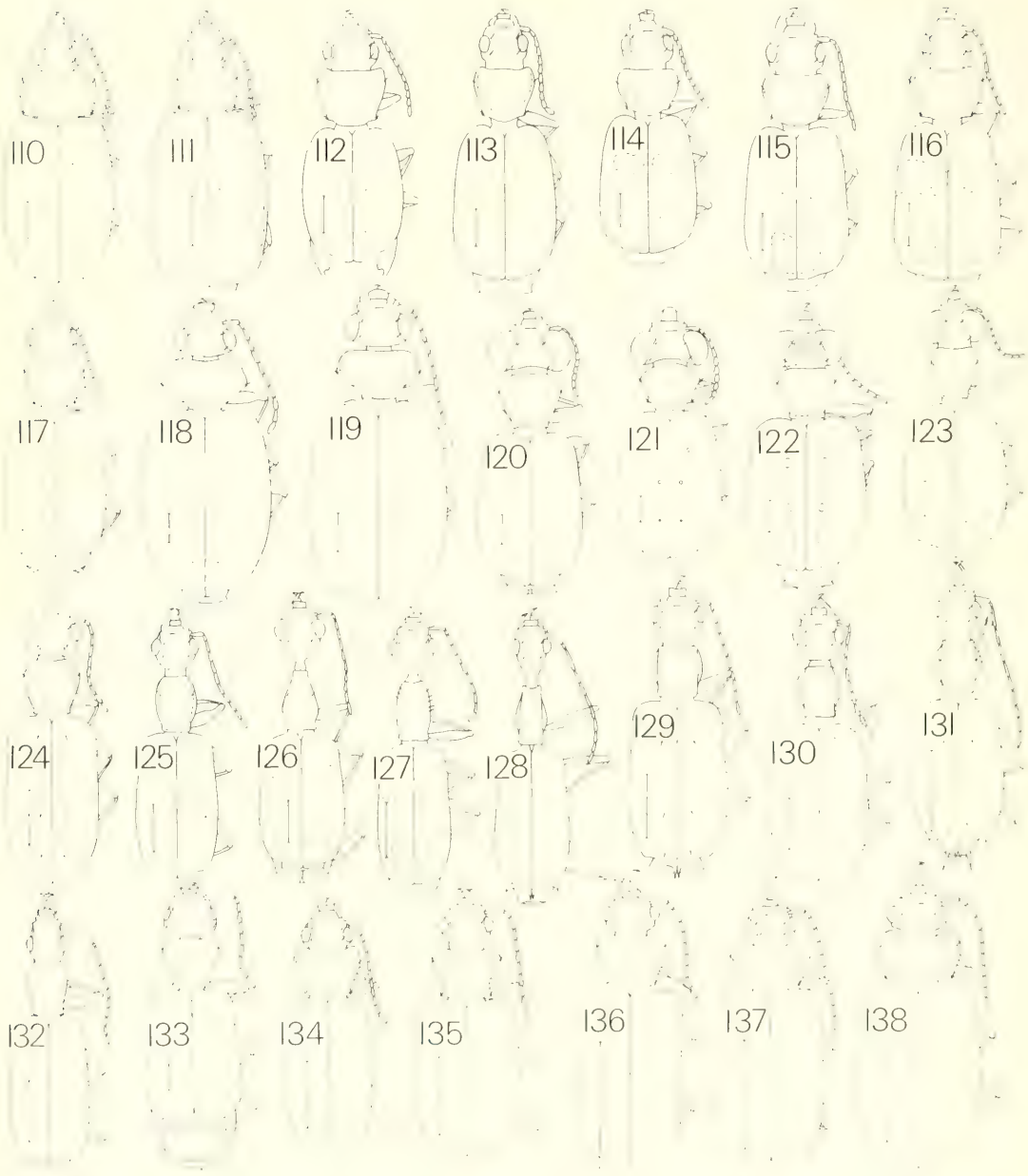

Fig. **110**, *Phloeocarabus euplenes* n. sp., ♂ paratype, Kiunga; **111**, *Trigonothops lateralis* n. sp., ♀ holotype; **112**, *Nototarus papua* n. sp., ♀ para., Dobodura; **113**, *Anomotarus gressitti* n. sp., ♀ holo. **114**, *A. ocellatus* n. sp., ♀ holo. **115**, *A. plagifer* n. sp., ♂ holo.; **116**, *A. transversus* n. sp., ♂ holo.; **117**, *A. wau* n. sp., ♀ holo.; **118**, *Pentagonica blanda* Andrewes, ♂ Dobodura; **119**, *P. papua* n. sp., ♀ para., Dobodura; **120**, *Parascopodes cyaneus* (Sloane), ♂ Dobodura; **121**, *Scopodes altus* n. sp., ♂ holo.; **122**, *S. cheesmani* n. sp., ♂ para., Cyclops Mts.; **123**, *S. adonis* n. sp., ♂ para., Mobitei; **124**, *Hexagonia papua* n. sp., ♂ para., Aitape; **125**, *Colliuris rossi* n. sp., ♂ holo.; **126**, *C. papua* n. sp., ♀ para., Dobodura; **127**, *Casnoidea puncticollis* (Sloane), ♀, Kiunga; **128**, *Clarencia quadridens* n. sp., ♂ para., Hollandia; **129**, *Dicraspeda bispinosa* n. sp., ♀ holo.; **130**, *Eudalia anomala* n. sp., ♀ para., Wasian; **131**, *Dobodura armata* n. gen. & sp., ♂ para., Dobodura; **132**, *Drypta papua* n. sp., ♀ holo.; **133**, *Zuphium sinuum* n. sp., ♀ holo.; **134**, *Planetes cordens* n. sp., ♀ para., Stephansort; **135**, *Pogonoglossus papua* n. sp., ♀ para., Dobodura; **136**, *P. major* n. sp., ♂ holo.; **137**, *P. latior* n. sp., ♀ para., Lower Mist Camp; **138**, *P. obliquus* n. sp., ♂ holo.

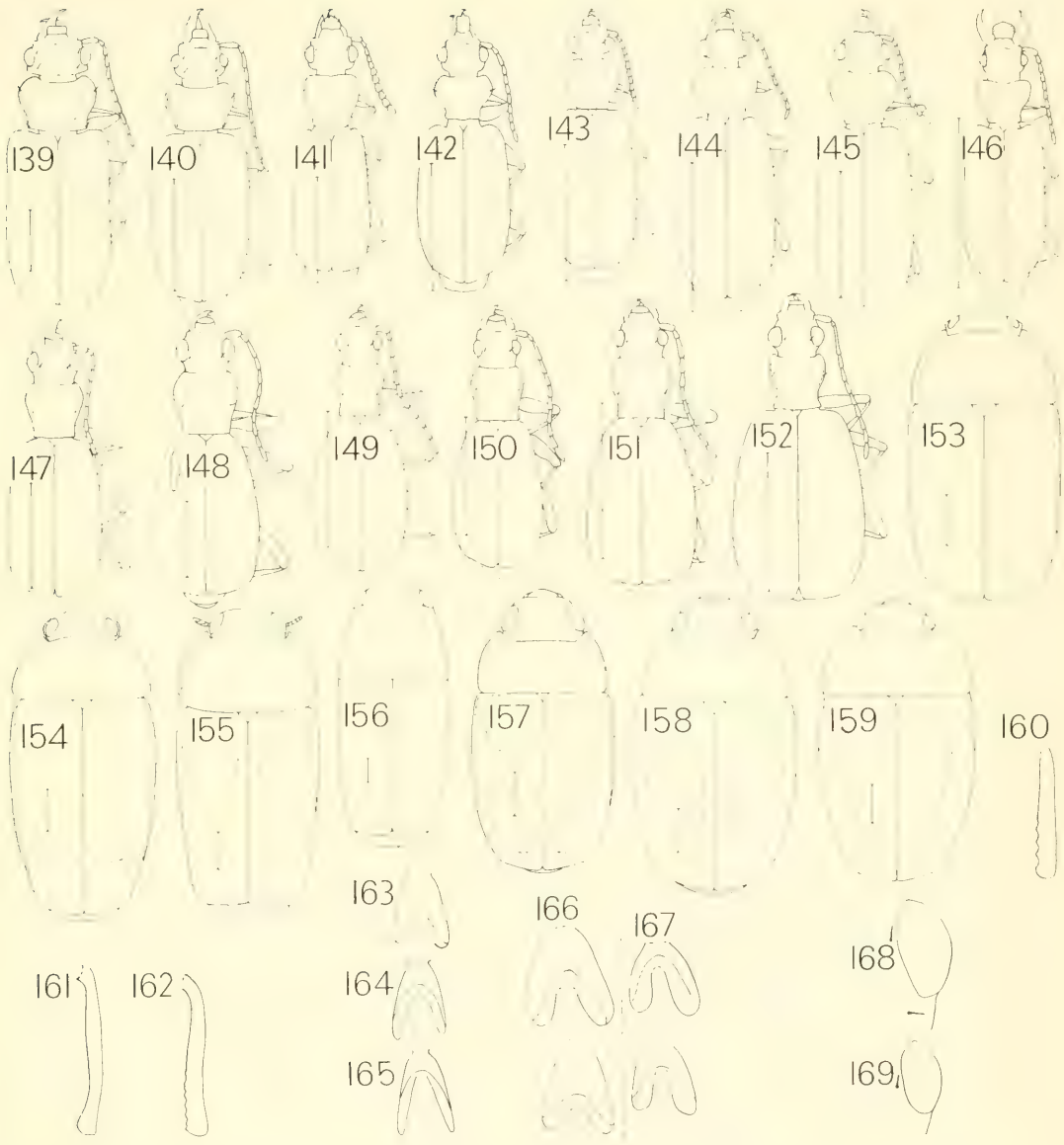

Fig. **139**, *Pogonoglossus parvus* n. sp., ♀ paratype, Dobodura; **140**, *P. glabricollis* Van Emden, ♀, Motae; **141**, *Helluodema unicolor* (Hope), ♂, Rouku; **142**, *Helluonidius chrysocomes* Maindron, ♀, Nabire; **143**, *H. laevifrons* n. sp., ♀ holotype; **144**, *H. latipes* n. sp., ♀ holo.; **145**, *H. politus* n. sp., ♀ holo.; **146**, *Helluopapua toxopei* n. gen. & sp., ♂ holo.; **147**, *Pheropsophus amnicola* n. sp.; **148**, *P. aptinomorphus* Heller, ♂ Maffin Bay; **149**, *P. pedes* n. sp., ♀ holo.; **150**, *P. catulus* n. sp., ♂ holo.; **151**, *P. canis* n. sp., ♀ holo.; **152**, *Brachinus papua* n. sp., ♀ para., Tanahmerah; **153**, *Adelotopus exactor* n. sp., holo.; **154**, *A. debitor* n. sp., holo.; **155**, *A. bijugus* n. sp., holo.; **156**, *Cryptocephalomorpha papua* n. sp., holo.; **157**, *Sphallomorpha quadrua* n. sp., holo.; **158**, *S. dupla* n. sp., holo.; **159**, *S. unita* n. sp., holo.; **160**, *Demetrida moda* n. sp., ♂ middle tibia, para., Dobodura; **161**, *D. brunnea* n. sp., same, holo.; **162**, *D. reversa* n. sp., same, holo.; **163**, *Dicraspeda brunnea* Chaudoir, 4th segment right hind tarsus (without setae), ♂, Dobodura; **164**, *D. bispinosa* n. sp., same, ♂ holo.; **165**, *D. longiloba* (Liebke), same, ♂, Dobodura; **166**, *Aristolebia papua* n. sp., 4th segments middle & hind tarsi (without setae), ♀ para., Wau; **167**, *A. capitis* n. sp., same, ♂ holo.; **168**, *Miscelus sibling* n. sp., right eye & supraocular setae, ♂ holo.; **169**, *M. unicolor* Putzeys, same, ♀, Wau.

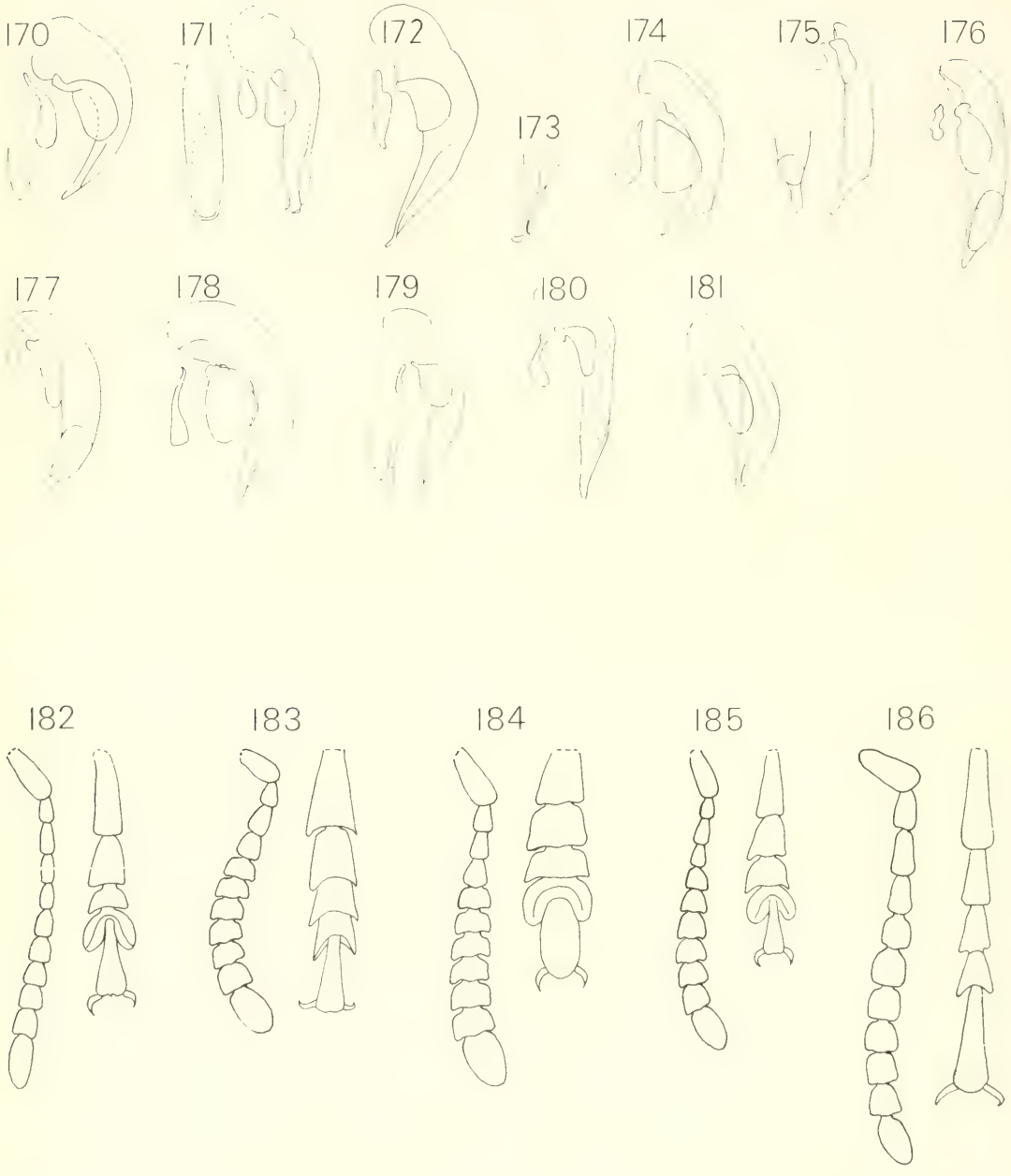

Fig. **170**, *Microferonia baro* n. sp., ♂ copulatory organs, holotype; **171**, *Chlaenius pan* n. sp., same, holo.; **172**, *Trichotichnus altus* n. sp., same, paratype, Wau 1200 m; **173**, *T. dux* n. sp., same (apex of middle lobe only), para., Wau 1700 m; **174**, *Lyter glaber* n. gen. & sp., same, para., Finschhafen; **175**, *Odontomasoreus humeralis* n. gen. & sp., same, para., Dobodura; **176**, *Coptodera grossa* n. sp., same, para., Wau; **177**, *Minuphloeus mixtus* n. gen. & sp., same, para., Wau; **178**, *Parascopodes cyaneus* (Sloane), same, Dobodura; **179**, *Colliuris rossi* n. sp., same, holo.; **180**, *Dobodura armata* n. gen. & sp., same, para., Dobodura; **181**, *Helluopapua toxopei* n. gen. & sp., same, holo.; **182**, *Helluonidius chrysocomes* Maindron, right antenna and right hind tarsus (without setae), ♀, Nabire; **183**, *H. laevifrons* n. sp., same, ♀ holo.; **184**, *H. latipes* n. sp., same, ♀ holo.; **185**, *H. politus* n. sp., same, ♀ holo.; **186**, *Helluopapua toxopei* n. gen. & sp., same, ♂ holo.

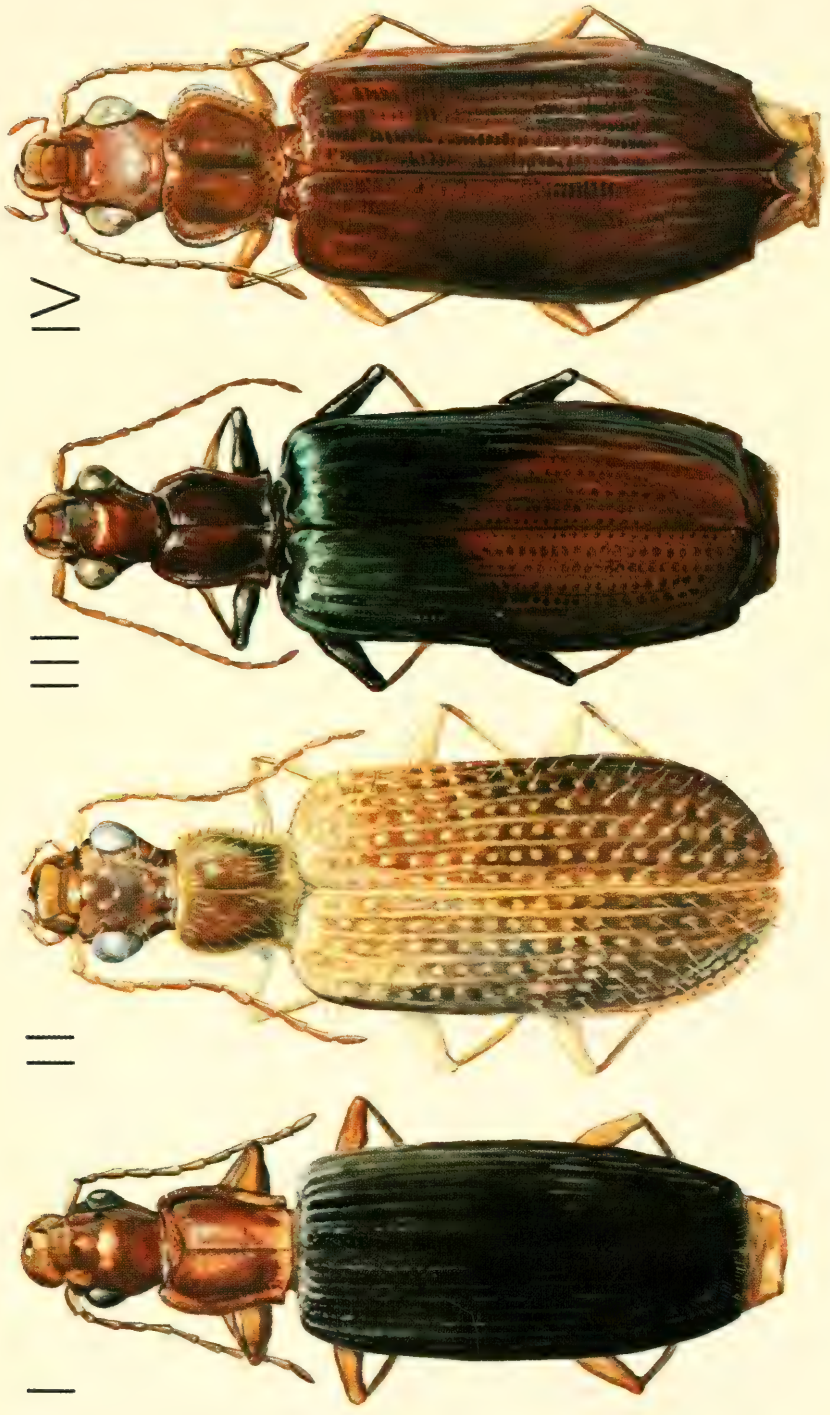

Plate 1

Fig. 1, *Demetrida nigripennis* n. sp., ♂ holotype. II, *D. pallens* n. sp., ♂ holotype. III, *D. nubicola* n. sp., ♀ holotype. IV, *D. moda* n. sp., ♀ paratype, Dobodura.

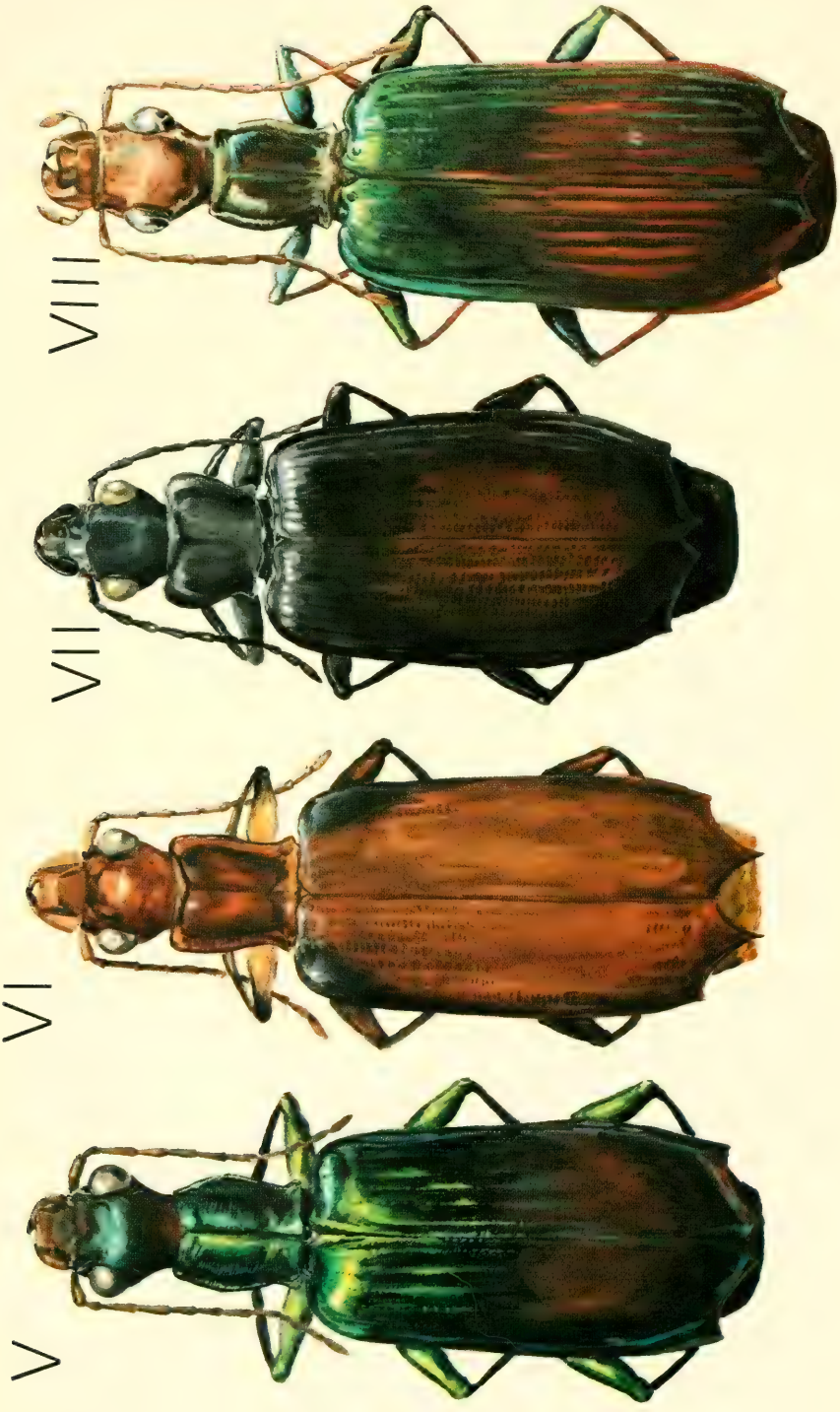

Plate 2

Fig. V, *Demetrida mafulu* n. sp., ♂ holotype. VI, *D. fumipes* n. sp., ♀ paratype, SE of Wau. VII, *D. dorsalis* n. sp., ♀ paratype, Wau. VIII, *D. diversa* n. sp., ♀ paratype, Wau.

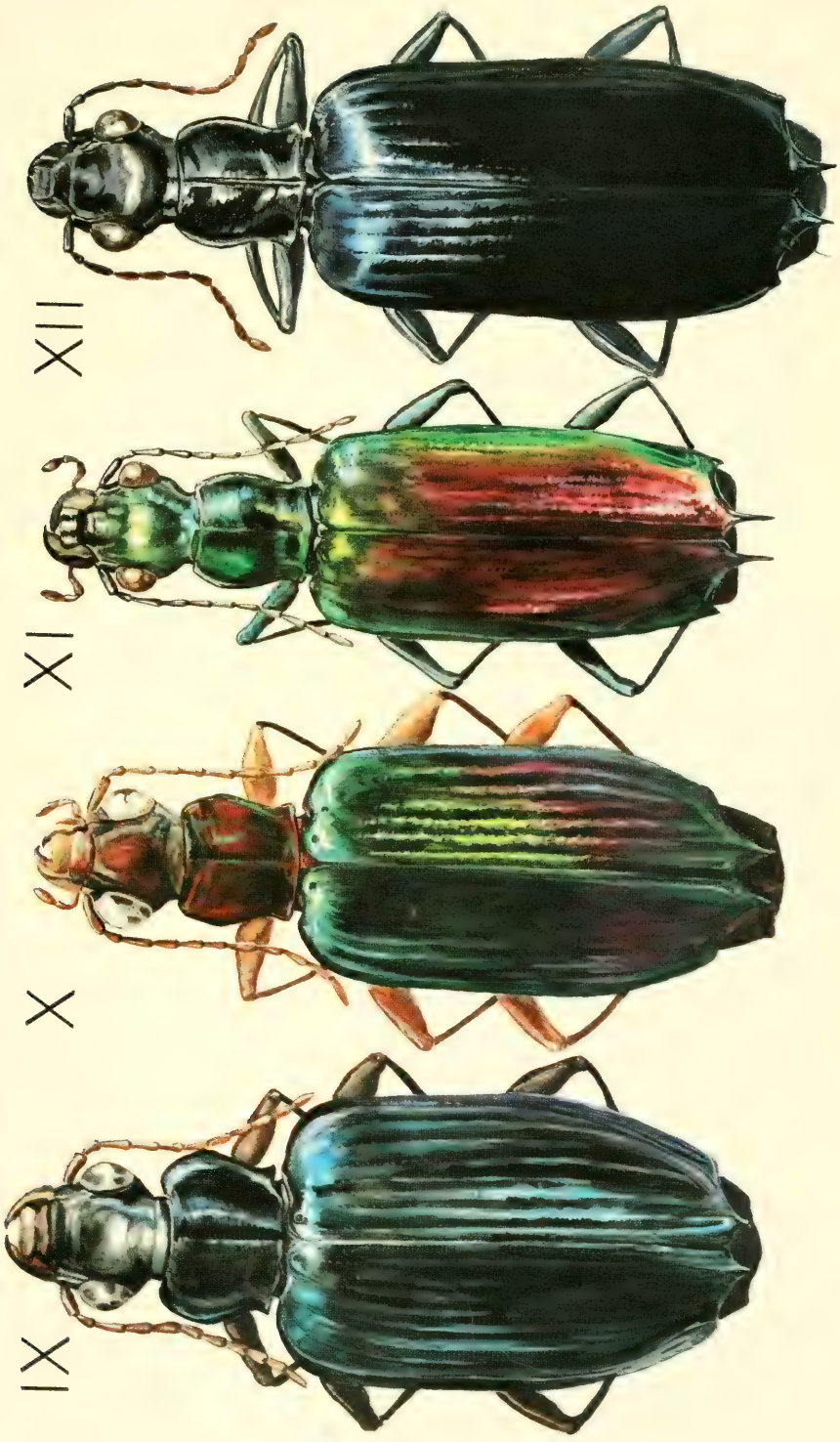

Plate 3

Fig. IX, *Demetrida imitatrix* n. sp., ♂ paratype, Sabron. X, *D. viridipennis* n. sp., ♂ holotype. XI, *D. lepida* n. sp., ♀ holotype. XII, *D. brandti* n. sp., ♀ paratype, Kiambavi.

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Geographic Variation in *Anolis distichus* Cope (Lacertilia, Iguanidae) in the Bahama Islands and Hispaniola

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GEOGRAPHIC VARIATION IN *ANOLIS DISTICHUS* COPE (LACERTILIA, IGUANIDAE) IN THE BAHAMA ISLANDS AND HISPANIOLA

ALBERT SCHWARTZ[1]

ABSTRACT

Anolis distichus is widely distributed in the Bahama Islands and Hispaniola, including the Hispaniolan satellite islands of Ile-à-Vache, Grande and Petite Cayemite, Isla Catalina, and Isla Saona. Analysis of variation in head scutellation, body color and chromatic repertory, and dewlap pigmentation shows that *A. distichus* is divisible into the following subspecies: *A. d. distichus*—Bahama Islands: New Providence, Exuma Cays, Long Island, Ragged Islands; *A. d. distichoides*—Bahama Islands: Andros; *A. d. biminiensis*—Bahama Islands: South Bimini; *A. d. dapsilis* new subsp.—Bahama Islands: Eleuthera; *A. d. ocior* new subsp.—Bahama Islands: Rum Cay and San Salvador. The status of the Cat Island populations is questionable. On Hispaniola, *A. distichus* has been divided into the following subspecies: *A. d. dominicensis*—most of Haiti and the northern half of the República Dominicana; *A. d. ignigularis*—central southeastern República Dominicana; *A. d. properus* new subsp.—extreme eastern República Dominicana; *A. d. sejunctus* new subsp.—Isla Saona; *A. d. tostus* new subsp.—Isla Catalina; *A. d. ravitergum* new subsp.—south central República Dominicana; *A. d. favillarum* new subsp.—Sierra de Baoruco in southwestern República Dominicana; *A. d. aurifer* new subsp.—central portion of Tiburon Peninsula in southwestern Haiti; *A. d. vinosus* new subsp.—southwestern portion of Tiburon Peninsula; *A. d. suppar* new subsp.—extreme tip of Tiburon Peninsula; *A. d. patruelis* new subsp.—Ile Grande Cayemite. *A. d. floridanus* has been re-established as a valid name for the continental Florida populations which do not agree with their Bahaman relatives; it is suggested that *floridanus* is in actuality a Bahaman form from the western portion of Andros Island. An extensive history of *A. distichus* is presented to account for the distribution and variation in the species.

INTRODUCTION AND ACKNOWLEDGMENTS

Anolis distichus Cope is a rather small and stocky anoline lizard which occurs throughout the islands of the Great Bahama Bank, Rum Cay and San Salvador, on Hispaniola and some of its satellite islands, and in Florida. The species was first described in 1861 from New Providence Island in the Bahamas. In 1863, Reinhardt and Lütken named *Anolis dominicensis* from Hispaniola and, although recognizing the similarities between the two species, considered *dominicensis* specifically distinct from *distichus*. Barbour (1937) apparently first combined the two species (as *A. d. distichus* and *A. d. dominicensis*). This

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combination was followed by Mertens (1939) and Cochran (1941); Mertens gave a thorough review of the subspecies of *A. distichus* which had been described in the 76 years between the naming of *A. dominicensis* and 1939. These subspecies include *altavelensis* Noble and Hassler (Isla Alto Velo off Cabo Beata, República Dominicana), *caudalis* Cochran (Ile de la Gonâve, Haiti), *juliae* Cochran (Ile-à-Vache, Haiti), and *wetmorei* Cochran (Isla Beata, República Dominicana), as well as *distichoides* Rosén (Andros Island, Bahama Islands). Mertens himself named two new subspecies from the República Dominicana (*ignigularis* and *albidogularis*) and resurrected *brevirostris* Bocourt as applicable to specimens from the vicinity of Barahona in the southwestern República Dominicana. Finally, Oliver (1948) described *A. d. biminiensis* from South Bimini Island in the western Bahamas and Smith and McCauley (1948) named *A. d. floridanus* from southern Florida. Thus, as presently understood, there are 12 subspecies of *A. distichus* recognized, of which three are Bahaman, eight occur on Hispaniola and its associated islets, and one is on the North American continent.

The present paper is a result of collections made by myself and parties in both the Bahama Islands and Hispaniola and of specimens and information gathered by Dr. Ernest E. Williams at the Museum of Comparative Zoology at Harvard University under grants from the National Science Foundation, B-16066 and GB-2444, and from the American Philosophical Society. Dr. Williams, who has for some time been involved with Hispaniolan anoles, recognized that some of the forms associated with *A. distichus* in actuality pertain to another (and similar) species, *A. brevirostris*. He suggested that he and I jointly work out the variation in *A. distichus* on Hispaniola as part of a rather extensive paper dealing with new data which have accumulated concerning these lizards on that island. But because of other duties, Dr. Williams has agreed to a partition of the larger work and has also suggested that I summarize the new information on *A. distichus* by myself. His collections of anoles made in Haiti and my own collections from the República Dominicana supplement one another very nicely, so that a more or less complete picture of the situation of *A. distichus* on the entire island of Hispaniola is now much more possible than heretofore. There are still certain gaps in our knowledge, and these will be pointed out in their proper places.

Most specimens which I have examined are in the Albert Schwartz Field Series (ASFS); a more limited amount of material has been borrowed from the American Museum of Natural History (AMNH), Carnegie Museum (CM), Field Museum of Natural History (FMNH), Museum of Comparative Zoology (MCZ), Richard Thomas (RT), University of Florida, Florida State Museum (UF/FSM), Museum of Zoology, University of Michigan (UMMZ), and United States National Museum (USNM). I am grateful to the following curators and their assistants for the loan of this supplemental material: Charles M. Bogert and George W. Foley, Neil D. Richmond, Robert W. Inger and Hymen Marx, Ernest E. Williams, Wayne King, Charles F. Walker, Doris M. Cochran and James A. Peters. Paratypes of new subspecies have also been deposited in the Academy of Natural Sciences of Philadelphia (ANSP), Museum of Natural History, University of Kansas (KU), and the University of Illinois Museum of Natural History (UIMNH). Since coloration and pattern play such a major role in differentiating the various subspecies of *A. distichus*, I have not considered it worthwhile to borrow all the available specimens of the species which exist in collections. Many of these older specimens are long preserved and now much faded. I have attempted to examine all material which might be assignable to new taxa proposed herein, and have examined all specimens which are designated

as paratypes. Lists of referred specimens in several cases include localities and museum numbers (MCZ) which I assign to certain taxa on the basis of provenance; specimens so listed have not been examined by myself. ASFS specimens have of course been studied in detail. The probability is high that almost all lizards listed as referred specimens are correctly designated subspecifically, since they have come from areas whose borders are delimited by fresh material which I have examined. Exceptional instances or uncertain allocations are noted in the text.

In the field I have had the capable assistance of Patricia A. Heinlein, Ronald F. Klinikowski, David C. Leber, Dennis R. Paulson, and Richard Thomas. Mr. Thomas succeeded in securing two distinctive subspecies of *A. distichus* on Isla Saona and Ile Grande Cayemite for me, and Messrs. Paulson and C. Rhea Warren made especial efforts to secure these lizards when they visited Cat Island, San Salvador, and Long Island on my behalf. Mr. Warren has also donated specimens collected by himself on South Bimini Island and in southern Florida. Carefully taken color notes from living specimens have been indispensable, and frankly, without them, the variational picture of *A. distichus* throughout its range would be impossible to interpret; I therefore wish to commend the efforts of others in this particular matter of information on fresh material, without which parts of the present paper would be in doubt.

I am particularly in the debt of David C. Leber, whose water color portraits of the various subspecies of *Anolis distichus* aid greatly in the visualization of the color differences in these lizards. Plates I and II are the result of Mr. Leber's work.[2] Of the 16 portraits, ten were executed in the field, often under trying circumstances; the remaining six were rendered from freshly preserved specimens and extensive color notes, at times additionally accompanied by Kodachrome transparencies. These latter portraits, completed under the critical eyes of myself and Richard Thomas (whose field notes are herewith gratefully acknowledged), are as accurate as those done in the field.

HISTORICAL SUMMARY

As noted in the introduction, there are 12 subspecies of *A. distichus*. However, these subspecies in actuality represent two species, whose prior names are *A. distichus* Cope and *A. brevirostris* Bocourt. Variation in the latter species, as well as its ecological interrelationships with *A. distichus*, are presently under study by Dr. Williams and need not concern us further here. In general, the two species are allotopic but broadly sympatric, although *A. distichus* is much more widely spread on Hispaniola than is *A. brevirostris*. In certain regions, however, the two species are precisely syntopic; in the most general terms, *A. brevirostris* inhabits xeric regions and *A. distichus* more mesic situations, but there are obvious and bold exceptions to this statement (for example, *A. distichus* on extremely hot and dry Isla Catalina off the southern Dominican coast).

The named forms which are correctly associated with *A. brevirostris* are *caudalis* Cochran and *wetmorei* Cochran, whereas the balance of the subspecies (*dominicensis, ignigularis, albidogularis, juliae, distichoides, biminiensis, floridanus*) are correctly associated with *A. distichus*. The most trenchant scale difference between the two species is the absence of a "preoccipital" scale in *A. brevirostris* and its presence in *A. distichus*. Even this character is not constant in either species, since most specimens of *A. distichus* from South Bimini and many from Andros lack the "preoccipital" (primarily by fusion with the interparietal), and occasional specimens from other Bahaman Islands (most commonly from Eleuthera) lack the "preoccipital" either by fusion with the interparietal or by frag-

[2] Publication of these plates has been made possible by N.S.F. grant GB-6944 to Ernest E. Williams.

mentation. Twenty-three *A. distichus* of a total of 1001 examined from Hispaniola and its satellites lack the "preoccipital," primarily by fragmentation (thus the area usually occupied by the "preoccipital" is crowded by a number of small scales) or by fusion with the interparietal—the latter being the less common condition. Of these 23 aberrant Hispaniolan *A. distichus*, none is from regions where *A. distichus* and *A. brevirostris* are sympatric, but three are from areas where *A. brevirostris* might be expected to occur (Llanos de Azua).

I have made no attempt to examine large series of *A. brevirostris* but have studied 46 specimens of this species from the Département de l'Ouest in Haiti (localities include the northern shore of the Golfe de la Gonâve, the Cul de Sac Plain and the southern coast in the Jacmel area) and the vicinities of Barahona and San Juan in the República Dominicana. In this lot of material, I find that the "preoccipital" is very variable in occurrence and shows an amount of variation equal to that in *A. distichus*. The scale is most often absent (fused or fragmented) in lizards from the Barahona area in the República Dominicana, but in Haitian material it is more often present, although at times tiny or small in size. The amount of overlap in size of the "preoccipital" in *A. distichus* and *A. brevirostris* is fairly broad, and there are many specimens of the latter that have a "preoccipital" as large as that of many specimens of the former. I do not interpret this condition as intergradation or hybridization, but as part of the variation of each species. There are pattern differences between the two species, since *A. brevirostris* has a pair of black nuchal spots, which is absent in *A. distichus*; no *A. brevirostris* ever assumes a green color, as do many subspecies of Hispaniolan *A. distichus*. As far as my observations are concerned, *A. brevirostris* is the smaller lizard, reaching a maximum snout-vent length in males of 47 mm, whereas *A. distichus* is generally larger, with the largest males of all races represented by large numbers having snout-vent lengths between 48 and 58 mm.

One name, *altavelensis*, has not been associated with either *A. distichus* or *A. brevirostris*. This form resembles *A. distichus* in having a "preoccipital," but, because of other differences, Dr. Williams suggests that it not be associated with this species and that it be considered as a species distinct from either *A. distichus* or *A. brevirostris*. The fauna of Isla Alto Velo presents consistent peculiarities when compared with that of adjacent Isla Beata and the Península de Barahona, and specific status for *A. altavelensis* is no exception, since both Isla Beata and the Península de Barahona south of the Sierra de Baoruco are inhabited solely by *A. brevirostris*. Thus *altavelensis*, with its "preoccipital," is unexpectedly like *A. distichus* (which occurs in this region exclusively in the Sierra de Baoruco and the eastern Massif de la Selle, and not in the lowlands or along the coast) rather than like *A. brevirostris*. Doubtless *A. altavelensis* has had a long independent history from the balance of *A. distichus*; a similar situation occurs in the Alto Velo *Leiocephalus* (which I have regarded as a peculiarly disjunct subspecies of the geographically removed *L. vinculum*; Schwartz, 1967).

The material on which the name *A. dominicensis* was based had as its provenance merely "Haiti"; Dr. Williams has examined the syntypes and assures me that they are indeed identical with those lizards which are currently called *A. d. dominicensis*, and not with *A. brevirostris*. With the description of several new mainland Hispaniolan subspecies of *A. distichus*, it is appropriate to restrict the type locality of *A. d. dominicensis* in order to clarify my concepts of that subspecies. I hereby designate Port-au-Prince, Département de l'Ouest, Haiti, as the type locality of *A. d. dominicensis*. It is not unlikely that the original specimens, collected by A. H. Riise, did indeed come from the vicinity of the capital of Haiti; Port-au-Prince has long

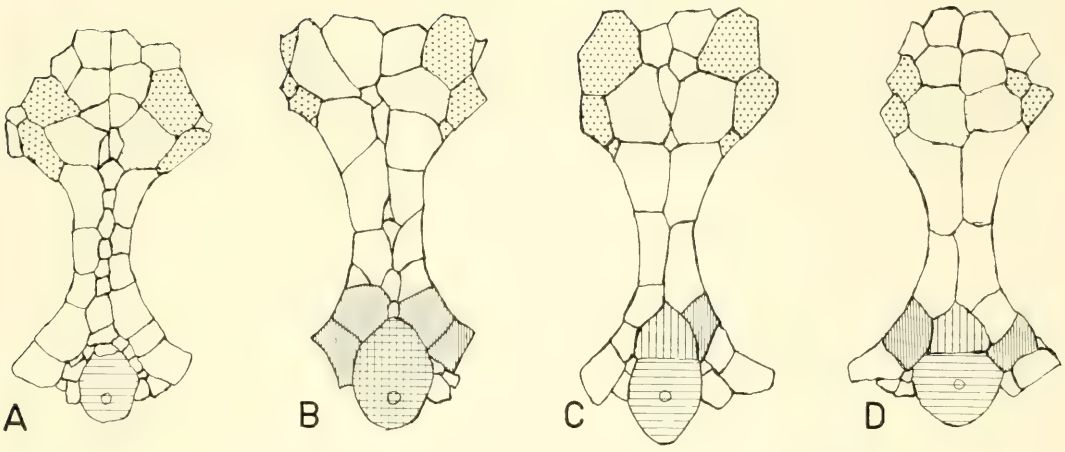


Figure 1. Partial dorsal views of heads of *Anolis distichus* showing modifications of head scales. Symbols: interparietal, widely spaced horizontal lines; "preoccipital," widely spaced vertical lines; supraorbitals in contact with interparietal, narrow vertical lines; median azygous head scales, dense stipple; postfrontals, open stipple; scales in lateral contact with postfrontals, heavy stipple.

A) ASFS 10283, Andros Island, Bahama Islands; 2/2 scales in lateral contact with postfrontals; supraorbital semicircles completely separated by a series of 10 median azygous head scales; "preoccipital" absent by fragmentation; 0/0 supraorbitals in contact with interparietal.

B) ASFS X4709, South Bimini Island, Bahama Islands; 3 scales in lateral contact with postfrontal on right side, left side abnormal; supraorbital semicircles in contact; 6 median azygous head scales; "preoccipital" absent by fusion with interparietal (denoted by overlap of symbols); 2/2 supraorbitals in contact with interparietal.

C) KU 93369, Carrefour Canon, Haiti; 3/3 scales in lateral contact with postfrontals; supraorbital semicircles in contact; 4 median azygous head scales, including "preoccipital" (denoted by shading); "preoccipital" present; 0/1 supraorbitals in contact with interparietal.

D) USNM 157924, 10 km W Baní, República Dominicana; 2/2 scales in lateral contact with postfrontals; supraorbital semicircles in contact; one (the "preoccipital," denoted by shading) median azygous head scale; "preoccipital" present; 1/1 supraorbitals in contact with interparietal.

been a prominent Caribbean seaport. Another possibility might be Cap-Haïtien, and assumption of this city as the source of the original *dominicensis* material would not alter my taxonomic conclusions, since I regard the populations of *A. distichus* at Cap-Haïtien as identical with those at Port-au-Prince. In favor of Port-au-Prince as the type locality of *dominicensis* is the (admittedly oblique) association of Riise with the type specimen of *Sphaerodactylus copei* Steindachner, a lizard which does occur in the environs of Port-au-Prince but not at Cap-Haïtien (see Schwartz and Thomas, 1965:317, for discussion of *S. copei*).

METHODS

When he described *A. d. biminiensis*, Oliver (1948) analyzed some Bahaman populations of *A. distichus* on the basis of various scale counts and relationships. Hoping that an application of his counts to non-Bahaman *A. distichus* might reveal differences other than coloration and pattern between various subspecies, I have followed his techniques and applied them to the material I have examined. Representations of several of the variant conditions are shown in Figure 1. The scale counts employed are:

1) Number of scales across the snout at the level of the second canthal scale. I follow Williams (1962:2) in making this count, in that the second canthal is reckoned from the anterior border of the orbit.

2) Number of loreal rows.

3) Scales between the supraorbital semicircles.

TABLE 1. SIXTEEN SUBSPECIES OF *Anolis distichus*, SHOWING STATISTICALLY SIGNIFICANT DIFFERENCES IN MEANS OF NUMBER OF MEDIAN AZYGOUS HEAD SCALES. SIZE OF SAMPLE IN FIRST COLUMN, MEANS AND TWO STANDARD ERRORS OF MEANS IN SECOND COLUMN. A PLUS IN TABLES INDICATES THAT THE TWO SUBSPECIES INVOLVED DIFFER SIGNIFICANTLY (NON-OVERLAP OF TWO STANDARD ERRORS OF MEAN); A MINUS INDICATES NO STATISTICAL DIFFERENCES. TWO SUBSPECIES (*sejunctus, tostus*) ARE NOT INCLUDED BECAUSE OF VERY SMALL SAMPLE SIZE.

	N	M	*distichus*	*distichoides*	*biminiensis*	*dapsilis*	*ocior*	*dominicensis*	*ignigularis*	*properus*	*ravitergum*	*favillarum*	*aurifer*	*vinosus*	*juliae*	*suppar*	*patruelis*	*floridanus*
distichus	126	6.0 ± .23	X	+	—	—	—	+	+	+	+	+	+	+	+	+	+	+
distichoides	160	8.7 ± .16		X	+	+	+	+	+	+	+	+	+	+	+	+	+	+
biminiensis	42	5.5 ± .78			X	—	—	+	+	+	+	+	+	+	+	+	—	+
dapsilis	101	6.2 ± .36				X	—	+	+	+	+	+	+	+	+	+	+	+
ocior	55	5.8 ± .49					X	+	+	+	+	+	+	+	+	+	+	+
dominicensis	235	3.9 ± .20						X	+	+	+	—	—	+	—	+	—	+
ignigularis	106	3.5 ± .08							X	+	+	—	—	—	—	—	+	+
properus	58	2.8 ± .16								X	—	+	+	+	—	+	+	+
ravitergum	49	2.6 ± .33									X	+	+	+	+	+	+	+
favillarum	26	3.8 ± .48										X	—	—	—	—	—	+
aurifer	64	3.7 ± .32											X	—	—	—	+	+
vinosus	100	3.4 ± .26												X	—	—	+	+
juliae	27	3.4 ± .46													X	—	+	+
suppar	174	3.4 ± .19														X	+	+
patruelis	25	4.6 ± .62															X	+
floridanus	90	7.9 ± .30																X

4) Number of rows of scales between supraorbital semicircles and interparietal scale. This figure is written as a fraction (i.e., 1/1, meaning that the interparietal is separated from the semicircles by one scale on each side). A count of 0/0 means that there are no scales between the semicircles and the interparietal, and that the semicircles and interparietal are thus in contact.

5) Number of subdigital lamellae on phalanges II and III of the fourth toe.

6) Number of scales bordering the postfrontal laterally (see Oliver, 1948:16, for drawings showing these scales in *A. distichus*). In a small number of specimens of *A. distichus*, the postfrontal may abnormally extend so far laterally as to make contact with one of the canthals. In such instances, I have not included the canthal as a scale in contact with the postfrontal, since the condition is obviously anomalous.

7) Number of median (usually azygous) scales posterior to the posteriormost paramedian pair of snout scales, usually restricted to the midline from the anterior border of the prefrontals posteriorly, and including the "preoccipital" as an unpaired median scale. Thus a count of 1, for example, means that between the anterior border of the postfrontals and the interparietal, there is only one scale (usually the "preoccipital"). A count of 0 occurs when the "preoccipital" is fused with the interparietal, provided that there are no additional median azygous scales. If some or all of the scales between the postfrontals are paired, but extremely irregularly so, the count includes these irregularly paired scales as median azygous scales, since they do not present the regular conformation of the paired paramedian snout scales of *A. distichus*. Table 1 shows the statistical significance of differences between subspecies in this character.

8) Number of supraorbital semicircle scales in contact with interparietal. This count is partly correlated with (4), the

Table 2. Sixteen subspecies of *Anolis distichus*, showing statistically significant differences in means of number of postmental scales. See Table 1 for details.

	N	M	*distichus*	*distichoides*	*biminiensis*	*dapsilis*	*ocior*	*dominicensis*	*ignigularis*	*properus*	*ravitergum*	*favillarum*	*aurifer*	*vinosus*	*juliae*	*suppar*	*patruelis*	*floridanus*
distichus	127	5.5 ± .22	X	+	+	—	+	+	+	+	—	+	+	+	+	+	+	+
distichoides	159	4.6 ± .14		X	—	+	+	+	+	+	+	+	+	+	+	+	+	—
biminiensis	42	4.8 ± .20			X	+	+	+	+	+	+	+	+	+	+	+	+	—
dapsilis	105	5.2 ± .21				X	+	+	+	+	—	+	+	+	+	+	+	+
ocior	56	6.7 ± .28					X		+	—	+	—		+	—	+	+	+
dominicensis	240	6.6 ± .13						X	+	—	+	—	+	+	+	+	+	+
ignigularis	105	6.0 ± .29							X	+		—	+	+	+	+	+	+
properus	58	6.7 ± .38								X	+	—	—	+	+	+	+	+
ravitergum	56	5.6 ± .34									X	—	+	+	+	+	+	+
favillarum	28	6.1 ± .41										X	+	+	+	+	+	+
aurifer	62	7.2 ± .28											X	—	—	—	—	+
vinosus	98	7.4 ± .27												X	—	—	—	+
juliae	31	7.2 ± .47													X	+	—	+
suppar	171	7.9 ± .22														X	—	+
patruelis	25	7.8 ± .48															X	+
floridanus	89	4.4 ± .23																X

number of rows of scales between the semicircles and the interparietal; for instance, if the latter count is 1/1, the number of supraorbital scales in contact with the interparietal will of necessity be 0/0. However, if the count of (4) is 0/0 (i.e., there are no scales between the semicircles and the interparietals), then (8) may have a fairly wide fluctuation.

9) Number of postmental scales. Table 2 shows the statistical significance of differences between subspecies in this character.

10) Presence or absence of a "preoccipital."

The above counts have been taken on 1588 specimens from Florida, the Bahamas, and Hispaniola. Some of them have proved to be useful, primarily on a modal rather than an absolute level, in defining the subspecies. Very small samples often show such a wide diversity in some counts that it is impossible to state with certainty what the modal condition is, but with increasingly large samples, in most cases a distinct mode can be easily determined for each of the counts. The degree of overlap between the various counts for the different samples is often great, so that it is difficult to identify a particular lizard to subspecies on the basis of any single count. Reliance must be placed on such features as dewlap pattern and coloration, and coloration and pattern of the head and body.

Of the counts taken, those of scales across the snout, number of loreal rows, and lamellae overlap so broadly between the samples and are so variable *intra se* that they serve no useful purpose insofar as diagnosing the subspecies is concerned. The data for these counts are presented in each case, but merely for the sake of completeness.

BAHAMAN VERSUS HISPANIOLAN POPULATIONS AS A WHOLE

The only statement contrasting the differences (if any) between all the Bahaman populations of *A. distichus* versus all the Hispaniolan populations is that of Cochran (1941:146) who noted that "In adult examples of *distichus* there are distinct keels on the enlarged scales of the femur, while in *dominicensis* these scales are always smooth. . . ." Examination of large num-

bers of *A. distichus* indicates that no such dichotomy exists, and the two major geographic subdivisions cannot be distinguished on the basis of presence or absence of keeled scales on the anterior femoral face. Additionally, no other scale character will separate the two segments of *A. distichus* absolutely, but there are a few characters which generally differentiate the two sections.

1) There is a tendency for Bahaman populations to have the supraocular semicircles completely separated by a single median row of azygous head scales. This character reaches its greatest development in the populations from South Bimini and Andros in the Bahamas, but occurs casually in all other Bahaman samples. No Hispaniolan specimen shows this character.

2) All Bahaman populations but one have 0/0 scales between the semicircles and the interparietal as the modal condition, whereas in Hispaniolan samples there are either 0/0 or 1/1 scales modally between the semicircles and the interparietal, with 1/1 having the higher incidence by population.

3) Median head scales in the Bahamas vary in mean from 5.5 to 8.7, whereas in Hispaniola the means vary from 2.6 to 5.0—the highest mean being probably higher than it is in reality, since the sample is composed of only six lizards. Table 1 shows the data on head scales.

4) The absence of the "preoccipital" scale is most frequently encountered in Bahaman populations and occurs only very rarely in Hispaniolan *A. distichus*, as previously pointed out. All Bahaman populations from which I have examined samples have at least one or a few specimens which lack the "preoccipital" scale, whereas only a very few Hispaniolan *A. distichus* lack this feature.

Although none of the above is completely diagnostic of Bahaman versus Hispaniolan *A. distichus*, it does suggest that there has been a greater divergence between the two major segments of *A. distichus* than between intra-Bahaman and intra-Hispaniolan populations.

There is also one suggestive color difference between Bahaman and Hispaniolan *A. distichus*. With one exception, all Bahaman populations are incapable of a true green phase. The general coloration of Bahaman lizards is a pale ashy gray to sandy tan, capable of becoming dark wood brown, although this latter condition is rather rarely observed. Very occasionally Bahaman lizards are observed to be a very pale ashy green, but bright or dark green lizards, such as occur in several Hispaniolan populations, are unknown from the Bahamas. The one Bahaman exception is lizards from Rum Cay and San Salvador; on these two isolated islands, *A. distichus* is distinctively colored (in reference both to other Bahaman and to Hispaniolan populations) in that it is regularly a pea-green or yellow-green. In fact, the yellow component of the dorsal pigmentation may be more striking than the green hues. The Rum Cay-San Salvador lizards are the only populations in the Bahamas where *A. distichus* is known to be greenish rather than gray or tan.

Many Hispaniolan subspecies of *A. distichus*, on the other hand, do indeed have a green phase, the greens varying from bright to a pale ashy (which is much more distinctly green than any green observed in Bahaman lizards other than those on Rum Cay and San Salvador). Even this color repertory distinction between the two segments of *A. distichus* is not absolute, since some Hispaniolan subspecies are not known to be able to assume the green phase, and thus resemble the Bahaman populations.

As far as dewlap coloration and pattern are concerned, the Bahaman *A. distichus* are very like some of their Hispaniolan relatives. Although I have no quantitative data, the dewlaps of Bahaman *A. distichus* appear smaller than do those of the Hispaniolan lizards, but this may be merely an artifact of observation or preservation techniques. The dewlap pattern and coloration of Bahaman *A. distichus* resemble those

of lizards from various Hispaniolan localities; the most aberrant dewlap pattern and colors occur in specimens from the extreme southwestern portion of the Tiburon Peninsula of Haiti and on its adjacent Ile-à-Vache.

SIZE AND NATURAL HISTORY

The largest specimens of *A. distichus* are from the southeastern uplands of Haiti. On the Montagne Noire in the vicinity of Peneau and Furcy, males reach a snout-vent length of 58 mm and females 48 mm. In general, in all populations, females reach a maximum size of about one centimeter less than males. The smallest of the maximally sized males (46 mm snout-vent length) are from Isla Catalina off the southern coast of the República Dominicana, and the smallest maximally sized female (38 mm) is from Isla Saona. However, the samples from both islands are very small (five males and one female from Saona; three males from Catalina), so that these comments are equivocal.

Etheridge (1966:351) stated that the largest Bahaman *A. distichus* he had examined had snout-vent lengths of 48 mm (New Providence, Andros, Cat) to 53 mm (Eleuthera). On the other hand, he noted that Hispaniolan specimens reached a maximum snout-vent length of about 50 mm. My own Bahaman data, based on 385 specimens in contrast to Etheridge's data for 126 specimens, do not agree with his Bahaman figures, since the maximally sized Eleuthera male (of 107 Eleuthera specimens) I have measured has a snout-vent length of 50 mm, slightly smaller than Etheridge's maximum for that island. The largest Bahaman males I have seen are from San Salvador and Rum Cay, and have snout-vent lengths of 53 mm, precisely the same as the largest male (from Eleuthera) examined by Etheridge. These discrepancies have little significance, but they indicate that populations on various Bahaman Islands do differ in maximum adult size.

A. distichus has a broad distribution on Hispaniola and is rivalled in this respect only by *Anolis ricordi* Duméril and Bibron, *Anolis cybotes* Cope, and *Anolis semilineatus* Cope. It occupies situations varying from mesic oases in otherwise extremely xeric regions (Cul de Sac–Valle de Neiba plain) to rain forest at high elevations; it even occurs in only slightly more shady areas within xeric areas themselves (vicinity of Monte Cristi, República Dominicana). Typically, *A. distichus* prefers shady and mesic forested or pseudo-forested situations, such as hardwood forests, coffee and cacao groves, mango-breadfruit-royal palm associations, overgrown and shady fencerows along abandoned fields, etc. In some areas it literally swarms, whereas in other and apparently quite similar areas it is extremely uncommon. *A. distichus*, in dense forest, often prefers large trees which extend above the lower canopy, and in cacao groves (where *A. distichus* and *A. cybotes* occur syntopically on the same trees), *A. distichus* in general seems to prefer the more exposed—and thus slightly more sunny—branches, although a mature cacao grove is inherently very deeply shaded and cool and often canopied by much larger forest trees. Sleeping *A. distichus* are not easily observed, as Rand (1962:11) pointed out. I saw none in Haiti in two months' fieldwork, and encountered the first sleeping individual near Miches in the República Dominicana; this lizard was on the upper surface of an herb leaf within two feet of the ground. In northwestern República Dominicana, near Palo Verde, in an extensive patch of flood plain hardwoods along the Río Yaque del Norte, Thomas and I encountered many *A. distichus* sleeping in company with *A. cybotes* and *A. chlorocyanus* Duméril and Bibron. Here *A. distichus* customarily slept on the leaves and twigs of small herbs and shrubs, within three feet of the ground, whereas both *A. cybotes* and *A. chlorocyanus* slept on the tips of small branches of saplings or on the tips of long and slender lianas and vines.

A. chlorocyanus slept distinctly higher in the canopy than *A. cybotes*, since no *A. chlorocyanus* was encountered below eight feet above the ground and most were above ten feet and inaccessible. Considering the occurrence at this locality of the vine-inhabiting and climbing snakes *Epicrates gracilis* Fischer and *Uromacer oxyrhynchus* Duméril and Bibron, the use of the tips of branches and pendant vines by *A. cybotes* and *A. chlorocyanus* is most suggestive; the distinctly lower and non-tree or vine associated sleeping sites for *A. distichus* may well have a distinct positive survival value in an area where these two primarily arboreal snakes are abundant.

A. distichus occurs in Hispaniola at elevations from below or near sea level (Valle de Neiba) to at least 6000 feet (1830 meters), in the Sierra de Baoruco, Massif de la Selle, and Cordillera Central.

In the Bahamas, *A. distichus* occurs with some frequency in hammock woods or coppice (South Bimini, New Providence), but also occupies (as Rand, 1962:4, noted for Hispaniolan *A. distichus*) isolated large and often gray-barked trees, such as *Ficus*, with whose bark coloration the Bahaman races blend excellently, and which additionally offer sanctuary among adventitious roots and buttresses. Other trees with which *A. distichus* is customarily associated in the Bahamas are *Coccoloba*, *Lysiloma*, and *Terminalia*; all have pale bark which renders the lizards inconspicuous. In Nassau, *A. distichus* occurs commonly on crannied limestone walls and street cutbanks, and on San Salvador the species was abundant about the ruins of Sandy Point House (= Watling's Castle), both on the surrounding trees and saplings and on the building itself.

On some Bahaman islands, *A. distichus* is quite common. Thus, it is abundant on New Providence and Eleuthera, for instance, and Oliver (1948:32) noted that C. M. Breder, Jr., secured a series of 164 *A. distichus* from native boys on Andros; my own observations on Andros do not indicate such a present abundance of *A. distichus*, however. On South Bimini, *A. distichus* is only moderately common; Oliver (*op. cit.*:22) secured 20 specimens from *Ficus* and *Coccothrinax*, but recent collectors have not secured these lizards so abundantly on South Bimini. At the other extreme of abundance lies Rum Cay, where *A. distichus* is distinctly uncommon; here the lizards were observed and collected primarily on *Cocos* palms and other trees in the settlement of Port Nelson, and only occasional individuals were observed away from human habitations. Only two individuals, both on Cat Island, have been noted sleeping in the Bahama Islands. Richard Thomas observed these lizards sleeping on small limbs, between 6 and 7 feet (± 2 meters) above the ground; one sleeping lizard was in a *Sabal* grove and the other in an open group of large trees surrounded by thorn scrub. Occasional individuals have been collected diurnally beneath rocks both inland and near the strand, so it is possible that Bahaman *A. distichus* resort also to such situations for nocturnal retreats.

Rand (1962) has summarized his observations on three Hispaniolan anoles (*A. distichus, A. cybotes, A. chlorocyanus*) both in the field in the República Dominicana and in the laboratory. My observations on *A. distichus* differ somewhat from his; for instance, he regarded this species as living "primarily on isolated trees and fence posts and along the edges of woods and trails in open woods." The abundance of *A. distichus* in Dominican cacao groves (admittedly an artificial situation) and in dense mesic woods high in the Cordillera Central is in contrast to Rand's statement. Such differences may well reflect different habits in different regions, and suggest that one species of anole may occupy varying habitats in different areas, and that extreme caution should be used in generalizing about the habitat preferences of geographically widely distributed anoles. It is also pertinent in this connection that Mertens (1939:15) reported the occurrence of *A.*

distichus (along with *A. cybotes*) in pine forest at Paso Bajito in the Cordillera Central. In the higher pine woods near Constanza, at elevations between about 4000 and 6000 feet (1220 and 1830 meters), *A. distichus* is at best rather rare, preferring in this region residual stands of rainforest. It has not been taken or observed in the vicinity of Valle Nuevo (about 8000 feet; 2440 meters) where *A. shrevei* Cochran is the commonest (and perhaps only) anole of the cool and open pine-forested slopes.

SYSTEMATIC ACCOUNT

Anolis distichus distichus Cope

Anolis distichus Cope, 1861, Proc. Acad. Nat. Sci. Philadelphia:208.

Type locality: New Providence Island, Bahama Islands.

Definition: A subspecies of *A. distichus* characterized by small size (males to 49 mm, females to 44 mm snout-vent length), dorsum pale ashy gray to sandy tan and without a green phase, dewlap pale yellow, rarely with a vague basal to more extensive orange blush, modally 0/0 scales between the supraorbital semicircles and the interparietal, 0/0 supraorbitals in contact with the interparietal, 2/2 scales in contact laterally with the postfrontals, and high mean number (6.0) of median azygous head scales.

Distribution: The Bahama Islands: known definitely from New Providence, the Exuma Cays (Warderick Wells Cay, Staniel [= Stanyard] Cay, Darby Cay), Great Exuma, Little Exuma, Long Island, and Great Ragged Island (Fig. 2).

Comments: *A. d. distichus* is widely distributed on the islands to the east of the Tongue of the Ocean on the Great Bahama Bank and presumably on the Ragged Islands. Specimens from Cat Island will be discussed later.

In life, *A. d. distichus* is normally a gray lizard, but some specimens are sandy tan in life. Occasional specimens demonstrate a boldly contrasting pattern of brownish black ground color with black crossbands; in this phase the snout is smudged with sooty black and the eyeskin is also sooty. Rarely some lizards show a very pale greenish gray phase. Although I have not so recorded it, I assume that *A. d. distichus* can become rich dark brown as can several of the other Bahaman subspecies. The dorsum is at best only very weakly longitudinally striate with darker, and there may be a single vague scapular chevron, its apex pointed posteriorly. The interocular dark bar is variable, but even when best expressed, is not especially prominent; other head markings are vague and ill defined. The venter is cream to very pale yellowish, and the underside of the tail is very pale yellow also. The dewlap is regularly pale yellow (Pl. I). Rarely is there a basal orange blush; if present, the orange is extremely faint and only barely discernible. Very occasional specimens (Long Island) have the pale orange more extensive.

The islands to which I have attributed the nominate subspecies may be conveniently divided for further discussion into four areas: 1) New Providence, 2) the Exuma Cays, including Great and Little Exuma, 3) Long Island, and 4) Great Ragged Island. The samples from these four areas are alike in dorsal coloration and pattern and presumably in dewlap color (I have not seen live Ragged Island specimens), and on these bases I group them together. In scale characters, there are some differences which may be pertinent, but I have chosen not to emphasize them. The following data are from a series of 49 New Providence specimens, 16 from the Exumas, 57 from Long Island, and 10 from Great Ragged Island. I have seen living specimens from New Providence and Long Island, and freshly preserved material from the Exumas.

Long Island and Great Ragged Island specimens modally have 0/0 scales between the semicircles and the interparietal, and 0/0 is one of two bimodes (each with 20 specimens) on New Providence. In the

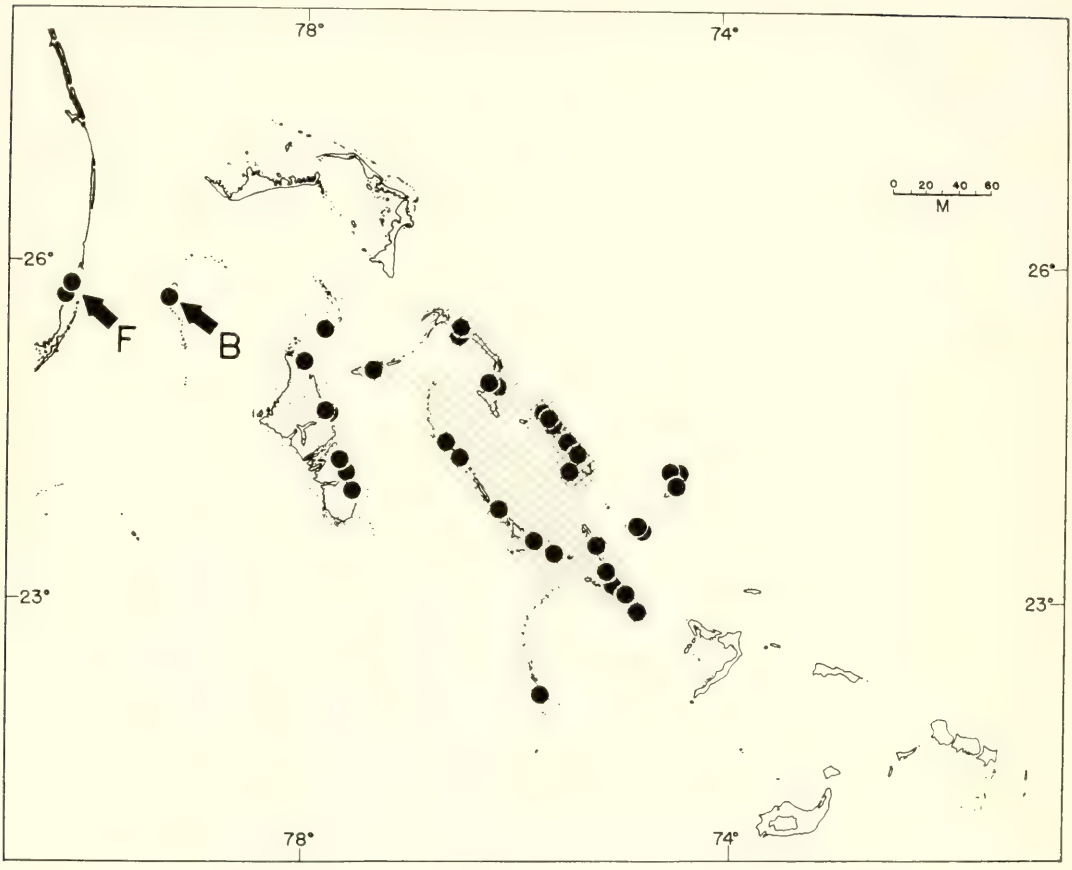


Figure 2. Map of the Bahama Islands, showing distribution of the subspecies of *Anolis distichus*; diagonal lines, upper left to lower right, *A. d. distichus*; diagonal lines, upper right to lower left, *A. d. dapsilis*; open stippling, *A. d. distichoides*; close stippling, *A. d. ocior*; F, *A. d. floridanus*; B, *A. d. biminiensis*; overlap of symbols for *A. d. distichus* and *A. d. dapsilis* suggests area of intergradation between these two subspecies.

specimens from the Exuma Cays, there are modally 1/1 scales between the semicircles and the interparietal. In number of supraorbitals in contact with the interparietal, 0/0 is the mode in all samples except that from Great Ragged, which has 1/1 modally (although 0/0 has a frequency of two lizards and 1/1 a frequency of three lizards). All samples modally have 2/2 scales in lateral contact with the postfrontals. The highest incidence of complete median separation of the supraorbital semicircles occurs on Long Island (four of 53 lizards), whereas New Providence has three of 46, the Exumas one of 16, and none occurs on Great Ragged. Scales across the snout range from 4 to 6 (New Providence), 8 (Exumas), or 7 (Long), and are either 5 or 6 on Great Ragged; modes 4 (New Providence), 5 (Great Ragged) and 6 (Exuma Cays, Long). Loreal rows vary from 3 to 5 on New Providence (mode 4), and 4 to 6 on the Exumas (mode 4) and Long (mode 5); loreal rows on Great Ragged are 4 or 5 (mode 4). Fourth toe lamellae vary from 15 to 20 (New Providence, the Exumas), 14 to 19 (Long), and 15 to 19 (Great Ragged), with modes of 18 in the former two samples and in the Great Ragged lizards, and 17 on Long Island. Median azygous head scales vary between 3 and 13 (mode 5, mean 6.2) on

New Providence, 3 and 9 (mode 5, mean 5.6) on the Exumas, 2 and 10 (mode 6, mean 5.9) on Long, and 3 and 10 (mode 6, mean 5.9) on Great Ragged. Postmentals vary from a low of 4 in all samples to 7 on New Providence, the Exumas, and Great Ragged, and 10 on Long. The mode is 4 on New Providence and the Exumas, and 6 on Long and Great Ragged. The means of postmentals are 5.0 (New Providence), 5.1 (Exumas), 5.4 (Long), and 5.3 (Great Ragged). The "preoccipital" is regularly present; one specimen from New Providence, one from the Exumas, one from Great Ragged, and four from Long lack this scale.

From the above data, it appears that a certain amount of divergence has taken place in the four areas which are inhabited by *A. d. distichus*. In general, the Exuma Cays material is closer in most counts to the lizards from New Providence (although the scales between the semicircles and the interparietal are a notable exception). The Long Island lizards, on the other hand, differ somewhat more. The sample from Great Ragged Island is too small for detailed comment. In the absence of any established chromatic or pattern differences, I place all four populations in the nominate subspecies, although I acknowledge the modal differences mentioned.

As noted above, *A. d. distichus* is common on New Providence, where it was observed abundantly in Nassau (especially on rock walls and exposed limestone street cuts), and on and about the limestone bluffs near the coast at Cave Junction. At the latter locality, the lizards occurred also on saplings and large *Ficus* about the bluffs, and on *Coccoloba* on the coast. In high coppice near Nassau East, *A. distichus* was extremely abundant, both on the trees and saplings and on an old rock wall which extended for some distance through the woods. The species is only moderately common in coppice on Great and Little Exuma.

Specimens examined: BAHAMA ISLANDS. *New Providence* (localities not mapped): Nassau, 23 (AMNH 76348–54 + 16); Cave Point, 3 (ASFS 10301–03); Cave Junction, 10 (ASFS V7206–15); 0.9 mi. (1.4 km) W Cave Junction, 2 (ASFS V7226–27); hills south of Lake Cunningham on Gladstone Road, 4 (ASFS V2092–95); Prospect Ridge, 2 (ASFS V2102–03); The Grove, 1 (ASFS V2104); Windsor Field, 1 (ASFS V2110); 0.6 mi. (1.0 km) NW Yamacraw Beach, 1 (ASFS V7242); 0.3 mi. (0.5 km) E Nassau East, 2 (ASFS V10638–39). *Exuma Cays*: Warderick Wells Cay, 3 (AMNH 76326–28); Staniel (= Stanyard) Cay, 5 (AMNH 76329–33); Darby Cay, 2 (AMNH 76334–35). *Great Exuma*: 3.2 mi. (5.1 km) NW George Town, 5 (ASFS V7033–36, ASFS V7053). *Little Exuma*: 5.7 mi. (9.1 km) SE The Ferry, 1 (ASFS V7043). *Long Island*: Simm's, 2 (MCZ 42282–83); Gray's Settlement, 5 (ASFS V8562–64, ASFS V8567–68); 2 mi. (3.2 km) E Gray's Settlement (not mapped), 3 (ASFS V8579–81); Deadman's Cay Settlement, 5 (UMMZ 115596); Clarence Town, 37 (MCZ 37986–95, MCZ 86931–53, UMMZ 80510–2 specimens, FMNH 25372–73); 3.6 mi. (5.8 km) SE Clarence Town (not mapped), 4 (ASFS V10835–38); Roses, 1 (FMNH 22750). *Great Ragged Island*: Duncan Town, 10 (UMMZ 118008–6 specimens; UMMZ 118009–4 specimens).

Anolis distichus distichoides Rosén

Anolis distichoides Rosén, 1911, Lunds Univ. Arrskr. N.F., Afd. 2, 7(5):29.

Type locality: Stanniard Creek, Andros Island, Bahama Islands.

Definition: A subspecies of *A. distichus* characterized by moderate size (males to 51 mm, females to 43 mm snout-vent length), dorsum grayish tan to gray and without a green phase, entire dewlap orange to yellowish-orange, modally 1/1 scales between the supraorbital semicircles and interparietal, 0/0 supraorbitals in contact with the interparietal, 2/2 scales in contact laterally with the postfrontals, and very

high mean number (8.7) of median azygous head scales correlated with the high incidence (about 50 per cent) of complete separation of supraorbital semicircles medially.

Distribution: The Bahama Islands: known from Andros Island (including Mangrove Cay) and the Berry Islands (known definitely from Frazer's Hog Cay) (Fig. 2).

Comments: The status of *A. d. distichoides* has been disputed in the past. The main claim for its recognition has been the orange dewlap (Pl. I), in contrast to the yellow dewlap of topotypical *A. d. distichus*. Although I have collected very few *distichoides* (as pointed out previously, I have observed it rarely on Andros), those males which I have seen in life have had an orange dewlap consistently. Scale data from 161 *A. d. distichoides* show the following: snout scales 4 to 8 (mode 6), loreal rows 4 to 6 (mode 5); supraorbital semicircles in contact in 108 specimens and completely separated by median azygous head scales in 51 lizards; modally 1/1 scales between semicircles and interparietal and 0/0 supraorbitals in contact with interparietal; 2/2 scales in lateral contact with postfrontals; fourth toe lamellae 15 to 21 (mode 18); median azygous head scales 3 to 14 (mode 9, mean 8.7); "preoccipital" more often present (84 lizards) than absent (74 lizards); postmentals 2 to 8 (mode 4, mean 4.6). The almost equal incidence of presence or absence of the "preoccipital" is noteworthy, although more *distichoides* have this scale than lack it. The high mean of median head scales is correlated with the high frequency of complete separation of the semicircles. No other subspecies of *A. distichus*, either Bahaman or Hispaniolan, has so high a mean, although it is approached most closely (7.9) by the mainland populations of *A. d. floridanus*. South Bimini *A. distichus* likewise have a high incidence of complete semicircle separation, but the mean number of median head scales is much lower (5.5).

The above scale features, especially the high number of median head scales and the high incidence of absence of the "preoccipital," as well as the frequent separation of the supraorbital semicircles, all differentiate *distichoides* from the nominate subspecies. Adult male *A. d. distichus* are also slightly smaller and have a yellow rather than orange or yellow-orange dewlap. Both subspecies resemble each other in dorsal color, although I have not noted *distichoides* being tan in life. As in the nominate subspecies, head markings are suppressed or absent in *distichoides*; the interocular bar is not prominent when present and is often absent. There may be a series of four dorsal chevrons, but these are often obscure or absent, and the degree of dorsal dark striation is likewise variable, with a strong tendency for the lizards to lack striae.

A. d. distichoides is the only Bahaman subspecies which modally has 1/1 scales between the semicircles and the interparietal. Sixty-five lizards fall into this category. On the other hand, 61 lizards have 0/0 scales between the semicircles and the interparietal, so the modality is not strong. The virtually bimodal condition in this scale character is not obviously due to the samples involved; since Andros is a very large island (nearly 100 miles long and up to 40 miles wide) and is much dissected by bights and minor waterways, it was conceivable that the two modalities were due to the pooling of data from two populations which are divergent in this character. This is not the case, since most of the *distichoides* sample under study are from Mangrove Cay, and within this lot of lizards the bimodality is clearly shown.

The size of Andros and the inaccessibility of its west coast is possibly significant in another matter. There is but a single *A. distichus* available from the entire west coast of Andros. This is a female (UF/FSM 18005); its sex precludes knowledge of dewlap color and its geographic uniqueness prevents an assessment of the characters of

the populations whence it was taken. The specimen is mentioned here and listed below as *A. d. distichoides*, but for several reasons I suspect that the population whence it was derived in actuality represents *A. d. floridanus*. Further comment upon this lizard will be made in the discussion of the history of the latter subspecies.

The occurrence of *A. d. distichoides* on the Berry Islands has not been previously reported. Two specimens from Frazer's Hog Cay collected by Richard Thomas are clearly referable to this subspecies; one is a male with an orange dewlap and the other a female. The male has the semicircles completely separated by a median row of 8 scales, and both lizards lack the "preoccipital." Possibly these two lizards might be better associated with the subspecies on South Bimini, but I consider them *distichoides* on the basis of provenance and the affinities of the Berry Islands fauna.

Specimens examined: BAHAMA ISLANDS. *Andros Island*: no further locality, 22 (UMMZ 80369–4 specimens, UMMZ 80377–11 specimens, 80381–6 specimens, UMMZ 80384); Morgan's Bluff (not mapped), 7 (UF/FSM 17626, UF/FSM 17628, UF/FSM 17630–32, UF/FSM 17634, UF/FSM 17637); ca. 0.5 mi. (0.8 km) N Nicholl's Town, 1 (ASFS V6972); Nicholl's Town (not mapped), 1 (UF/FSM 18013); Coakley Town, 4 (MCZ 41986–89); south side, mouth of Fresh Creek, 10 (ASFS 10280–86, UMMZ 115598–3 specimens); Mangrove Cay, 103 (MCZ 42013 + 15 untagged specimens, AMNH 63073–19 specimens, UMMZ 260210–4 specimens, UMMZ 109223–5 specimens, UMMZ 115597–34 specimens, plus 25 untagged specimens from AMNH 63067); south side, South Bight, 1 (MCZ 42001); Little Creek, 5 (UMMZ 118006); Pure Gold (not mapped), 15 (MCZ 42026–29 + 11 specimens); west coast, 2 mi. (3.2 km) at 55° from mouth of Deep Creek (not mapped), 1 (UF/FSM 18005). *Berry Islands*: Frazer's Hog Cay, 2 (ASFS V10667–68).

Anolis distichus biminiensis Oliver

Anolis distichus biminiensis Oliver, 1948, Amer. Mus. Novitates, No. 1383:16.

Type locality: Western end of South Bimini Island, Bahama Islands.

Definition: A subspecies of *A. distichus* characterized by small size (males to 50 mm, females to 44 mm snout-vent length), dorsum pale gray and without a green phase, dewlap orange, modally 0/0 scales between the supraorbital semicircles and the interparietal, 2/2 supraorbitals in contact with the interparietal, 3/3 scales in contact laterally with the postfrontals, and high mean number (5.5) of median azygous head scales.

Distribution: The Bahama Islands: known only from South Bimini (Fig. 2).

Comments: At the time of the description of *A. d. biminiensis*, Oliver had twenty specimens of this subspecies. Additional lizards taken since that time confirm his diagnosis of the race. Most striking, in comparison with all other subspecies, is the postfrontal contact with 3/3 scales laterally and the modal 2/2 supraorbitals in contact with the interparietal. Data for the series of 44 specimens are: snout scales 4 to 6 (mode 4), loreal rows 4 to 6 (mode 5); supraorbital semicircles in contact in 30 specimens and completely separated by median azygous head scales in 13 lizards; modally 0/0 scales between semicircles and interparietal and 2/2 supraorbitals in contact with interparietal; fourth toe lamellae 14 to 19 (mode 16); median azygous head scales 1 to 10 (mode 5, mean 5.5); "preoccipital" usually absent (41 of 44 lizards; see comments below); postmentals 4 to 6 (mode 5, mean 4.8). Of the three lizards which have the "preoccipital" present, in one (AMNH 68638) the scale is very tiny and in the second (AMNH 68637) the scale which I consider the "preoccipital" may in actuality be a fragment of the interparietal. Only in one lizard (CM 32552) is there an unequivocal "preoccipital" present. In having such a high percentage of absence

(by fusion) of the "preoccipital," *biminiensis* stands alone among all subspecies of *A. distichus*.

Aside from the scale characters noted above, *A. d. biminiensis* differs from *A. d. distichus* in the color of the dewlap—orange in the former (Pl. I) and yellow in the latter. In this feature *biminiensis* resembles *distichoides*; it seems very likely that the population on South Bimini is a direct derivative of *distichoides* on Andros, with resulting intensification by isolation of some of the characters of the Andros subspecies.

A. d. biminiensis usually is a gray lizard, but it is capable of turning a rich velvety brown. The shade of the orange dewlap is that of plate 9 I 10 and plate 10 L 9; all color designations are from Maerz and Paul, 1950. The venter is creamy to whitish or grayish, and the underside of the tail and hindlimbs has been noted as pale yellow (pl. 17 J 1). Head markings and dark body striae are usually obsolete, but the interocular bar is at least often indicated, and young lizards show both the interocular bar and an occipital dark V.

Oliver (1948:22) noted that *A. d. biminiensis* was encountered at low heights on light gray colored trees such as *Ficus* and *Coccothrinax*. More recently *biminiensis* has been collected on trees in hammock woods (high coppice) as well as on isolated *Ficus*. The absence of *A. distichus* from North Bimini is puzzling. Sutcliffe (1952) did not report the species from North Cat Cay south of South Bimini in the chain, but Wayne King advises me that he has collected the species in this chain but the specimens have been lost. Presumably the absence of *A. d. biminiensis* from North Bimini (paralleled by that of *Sphaerodactylus decoratus flavicaudus* Barbour, which also occurs, among the Biminis, only on South Bimini) is due to a fluke of colonization from Andros, and the lizards have been unable to cross even the narrow water gap between South and North Bimini.

Specimens examined: BAHAMA ISLANDS. *South Bimini*: no other locality, 3 (MCZ 80132–34); western end, 12 (ASFS X4709–15, ASFS X4721–24, ASFS X4932); western part, 2 (ASFS V10750–51); west end, 27 (AMNH 68637–38 + 6 specimens, AMNH 68639 + 8 specimens, MCZ 49739–40, UMMZ 118303, CM 34118–20, CM 32549–52).

Anolis distichus dapsilis[3] subsp. n.

Holotype: MCZ 81139, an adult male, from ocean side, opposite Hatchet Bay, Eleuthera Island, Bahama Islands, one of a series taken 15 June 1966 by Richard Thomas. Original number V10385.

Paratypes (all from Eleuthera Island, Bahama Islands): ASFS V10386–405, same data as holotype; ASFS 17144–49, Alicetown, 23 October 1961, native collector; ASFS 17167–74, Alicetown, 24 October 1961, native collector; ASFS 17176–82, Alicetown, 25 October 1961, native collector; AMNH 96509–15, ANSP 27163–69, CM 40623–29, KU 93380–86, MCZ 92001–08, UIMNH 61696–700, UF/FSM 21526–33, USNM 160692–99, Alicetown, 26 October 1961, native collector; ASFS 17498–500, Alicetown, 30 October 1961, native collector; ASFS 17151, Hatchet Bay (not mapped), 24 October 1961, A. Schwartz; ASFS V6799–800, 4 mi. (6.4 km) N Rock Sound, 2 October 1965, R. Thomas; ASFS V6864, 4 mi. (6.4 km) NW, thence ca. 2 mi. (3.2 km) E Rock Sound, 5 October 1965, R. Thomas; ASFS V6811, Southeast Point, 4 October 1965, R. Thomas.

Definition: A subspecies of *A. distichus* characterized by small size (males to 50 mm, females to 45 mm snout-vent length), dorsum pale ashy gray with a yellowish cast and without a green phase, dewlap orange with occasionally a very narrow yellow border, modally 0/0 scales between the supraorbital semicircles and the interparietal, 0/0 and 1/2 supraorbitals in contact with interparietal, 2/2 scales in contact laterally with the postfrontals, and

[3] From Latin, *dapsilis*, plentiful.

high mean number (6.2) of median azygous head scales.

Distribution: The Bahama Islands: known only from Eleuthera Island (Fig. 2).

Comments: The holotype has the following measurements and scale counts: snout-vent length 50 mm, tail 42 mm, distal half regenerated; 4 scales across snout, 4 loreal rows, semicircles in contact, 0/0 scales between supraorbital semicircles and interparietal, 2/2 supraorbitals in contact with interparietal, 2/2 scales in lateral contact with postfrontals, 15 fourth toe lamellae, 4 median azygous head scales, "preoccipital" present, 4 postmentals.

Scale counts for the series of 107 *A. d. dapsilis* are: snout scales 4 to 7 (mode 6), loreal rows 3 to 5 (mode 4); supraorbital semicircles in contact in 99 specimens and completely separated by median azygous head scales in six lizards; modally 0/0 scales between semicircles and interparietal and 0/0 and 1/2 (both with 24 lizards) supraorbitals in contact with interparietal; 2/2 scales in lateral contact with postfrontals; fourth toe lamellae 14 to 20 (mode 17); median azygous head scales 2 to 11 (mode 6, mean 6.2); "preoccipital" usually present (93 of 107 lizards); postmentals 4 to 9 (mode 6, mean 5.2).

The dorsum of *A. d. dapsilis* is usually pale ashy gray with a yellowish cast, and the head in adults regularly lacks any darker markings, including the interocular dark bar. In subadults and juveniles, the interocular bar and occipital V are somewhat more obvious. The dorsum lacks longitudinal dark striae but may be vaguely streaked with darker gray. The dewlap is completely orange, or orange with a very narrow yellow edge; hues noted for the dewlap are those of plate 11 C 10 and plate 10 E 12, and the yellow border has been noted as that of plate 10 H 3. The eye ring is white and the eye skin gray or tan, the latter in contrast to the gray head and dorsum. There is no evidence that *dapsilis* has a dark brown phase, but I assume that this color occurs. One lizard was recorded as being pale gray with a very faint greenish cast when caught.

A. d. dapsilis differs from *A. d. distichus* in dewlap color (orange versus pale yellow) and in reaching a very slightly larger size; in this latter context, Etheridge (1966: 351) reported 48 mm as the maximum size for New Providence specimens and 53 mm as a maximum on Eleuthera. Although none of the 107 *A. d. dapsilis* examined by me is so long as that reported by Etheridge, his data indicate that *dapsilis* is even larger than *A. d. distichus*.

The Eleuthera subspecies resembles *distichoides* and *biminiensis* in dewlap color. It differs from these two more western subspecies in several ways: the 2/2 lateral postfrontal contact separates *dapsilis* from *biminiensis* with 3/3, and the higher mean number of median head scales (8.7) in *distichoides* differentiates that form from *dapsilis* (with 6.2). *A. d. biminiensis* and *A. d. distichoides* both have the supraorbital semicircles more often separated than does *dapsilis*, and both the western subspecies more regularly lack the "preoccipital."

The holotype and paratopotypes from the ocean side of Eleuthera at Hatchet Bay were taken from saplings around the edges of an abandoned and overgrown *Cocos* grove. The specimens from Alicetown were from an edificarian situation. *A. d. dapsilis* is common on Eleuthera; I observed many at Hatchet Bay Plantation on isolated *Lysiloma* trees on the lawns and in high coppice between Hatchet Bay and The Glass Window. Considering the quantity of specimens examined by me, as well as many more in collections which I have not studied, *A. d. dapsilis* must be the commonest subspecies of *A. distichus* in the Bahamas.

Anolis distichus ocior[4] subsp. n.

Holotype: MCZ 81140, an adult male, from Port Nelson, Rum Cay, Bahama Islands, one of a series taken 20 June 1966

[4] From Latin, *ocior*, more rapid.

by Albert Schwartz and Richard Thomas. Original number V10488.

Paratypes (all from Rum Cay, Bahama Islands): ASFS V10489–90, ASFS V10493–94, MCZ 81147–48, same data as holotype; ASFS V10418–21, Summer Point, 17 June 1966, R. Thomas; ASFS V10446, Port Nelson, 17 June 1966, R. Thomas; ASFS V10473, Summer Point, 18 June 1966, R. Thomas.

Associated specimens: BAHAMA ISLANDS. *San Salvador* (localities not mapped): no further locality, 7 (MCZ 36729–31, FMNH 222, FMNH 225–26, FMNH 263); Cockburn Town, 19 (ASFS V2277, ASFS V2279–81, ASFS V2297–302, ASFS V2355–60, ASFS V2285); 4.2 mi. (6.7 km) N Cockburn Town, 1 (ASFS V10572); 9.9 mi. (14.9 km) by road N Cockburn Town, 1 (ASFS V10539); 7.1 mi. (11.4 km) N Cockburn Town, 1 (ASFS V2292); 1.2 mi. (1.9 km) N Dixon Hill, 1 (ASFS V2278); Dixon Hill, 3 (ASFS V2286–88); Sandy Point House, 7.6 mi. S Cockburn Town, 10 (ASFS V10559–67, RT 1464); 2.3 mi. (3.7 km) E Watling's Castle (= Sandy Point House), 1 (ASFS V2339); *Green Cay*, 1 (ASFS V10625); *Man Head Cay*, 1 (ASFS V2337).

Definition: A subspecies of *A. distichus* characterized by moderate size (males to 53 mm, females to 48 mm snout-vent length), dorsum yellow-gray to brown with a prominent pale flank stripe between the fore- and hindlimbs bordered above and below by dark brown or gray and with a pea-green phase, dewlap pale yellow, modally 0/0 scales between the supraorbital semicircles and the interparietal, 1/1 supraorbitals in contact with the interparietal, 2/2 scales in contact laterally with the postfrontals, and high mean number (5.8) of median azygous head scales.

Distribution: The Bahama Islands: known from Rum Cay and San Salvador, including its satellites Green Cay and Man Head Cay (Fig. 2).

Comments: The holotype has the following measurements and scale counts: snout-vent length 53 mm, tail ca. 90 mm; 6 scales across snout, 4 loreal rows, semicircles in contact, 1/1 scales between supraorbital semicircles and interparietal, 0/0 supraorbitals in contact with interparietal, 3/3 scales in lateral contact with postfrontals, 19 fourth toe lamellae, 7 median azygous head scales, "preoccipital" present but somewhat fragmented, 7 postmentals.

Scale counts for the series of 59 *A. d. ocior* are: snout scales 4 to 8 (mode 6), loreal rows 3 or 4 (mode 4); supraorbital semicircles in contact in 49 specimens and completely separated by median azygous head scales in nine lizards; modally 0/0 scales between semicircles and interparietal and 1/1 supraorbitals in contact with interparietal; 2/2 scales in lateral contact with postfrontals; fourth toe lamellae 15 to 19 (mode 17); median azygous head scales 2 to 10 (mode 6, mean 5.8); "preoccipital" usually present (55 of 57 specimens); postmentals 5 to 9 (mode 7, mean 6.7).

Dorsally, Rum Cay *A. d. ocior* varies from unstriate gray to brown, but most specimens observed were some shade of green, from a grayish pastel green to a rich pea-green. There is a complete cream labial stripe which extends above the shoulder and continues down the flank between the fore- and hindlimbs and is bordered both above and below by dark gray (dark gray-green in the green phase) or brown. The green phase of *ocior* is fairly bright, but not so bright a green as, for example, *Anolis carolinensis*. In the green phase there are no head markings, but an occipital V is often present in the gray phase. The dewlap is yellow (Pl. I). The venter is a rich yellowish tan in all phases, slightly brighter (more yellow) under the tail and along the lower lips.

Specimens from San Salvador differ from those from Rum Cay described above in that they do not show the green phase so consistently nor quite so brightly. The cream subocular mark is conspicuous, and the flank stripe is present but not so distinct nor so regularly bordered with darker as in

Rum Cay lizards. The dewlap is yellow on San Salvador. In scutellation, Rum Cay and San Salvador specimens are completely comparable in both modes and means in all counts taken; the largest female (48 mm) is from the small series from Rum Cay, whereas the largest female from the much longer San Salvador series is smaller (44 mm). I group the lizards from these two islands together, since it is apparent that they are derivative populations which together are more divergent from the balance of the Bahaman populations than they are from one another. Isolation on San Salvador and Rum Cay has resulted in some differentiation *in situ*, but not sufficient for nomenclatorial recognition.

A. d. ocior differs from all other Bahaman subspecies in having a green phase. From *biminiensis*, *distichoides* and *dapsilis*, *ocior* differs in having a yellow rather than an orange dewlap. The Rum Cay-San Salvador subspecies resembles *A. d. distichus* in dewlap color, but has 1/1 supraorbitals in contact with the interparietal in contrast to 0/0 in the nominate race, and also is larger and has a green phase, which *A. d. distichus* lacks. *A. d. ocior* is the only Bahaman subspecies with 1/1 supraorbitals in contact with the interparietal, and has the highest mean number of postmentals (6.7) of any Bahaman subspecies; the highest postmental mean other than that of *ocior* is that of *distichus* (5.5) among the Bahaman subspecies.

On Rum Cay, *A. d. ocior* is uncommon; all of our specimens were taken in edificarian situations, especially on *Cocos*, *Lysiloma*, and *Terminalia* in Port Nelson and on a *Lysiloma* near a cottage at Summer Point. Lizards were also observed on *Thrinax* palms near the beach, but not commonly. On San Salvador, *A. d. ocior* is more abundant, but is still not so common as is *A. d. distichus* on New Providence or *A. d. dapsilis* on Eleuthera, for instance. Specimens were collected on *Ficus* and *Terminalia* in Cockburn Town and were observed on exposed fence posts in company with *Anolis sagrei*; the latter species was more common in such situations. At Sandy Point House, *A. d. ocior* was extremely abundant on saplings about the ruins and on the walls of the ruins themselves. On Green Cay, *A. d. ocior* is moderately common on *Coccoloba* tangles, and the single lizard from Man Head Cay was taken under a flat rock among strand plants.

Rum Cay and San Salvador stand isolated from the Great Bahama Bank on two separate banks of their own. Rum Cay lies closest to Long Island (which is inhabited by *A. d. distichus*), whereas San Salvador is about equidistant from Long Island and Cat Island (but is closer to Rum Cay than to either of these). Aside from *Cyclura rileyi* Stejneger and *Leptotyphlops columbi* Klauber which are endemic to San Salvador, and *Sphaerodactylus corticola* Garman which occurs on both islands, the herpetofauna of Rum Cay and San Salvador is depauperate. Doubtless *A. d. ocior* has been a long resident of these two islands; it has diverged strikingly from the balance of the Bahaman subspecies.

Cat Island

Cat Island, located on its own bank along with Little San Salvador, lies southeast of Eleuthera (which is inhabited by *A. d. dapsilis*), east of the Exuma Cays (which are inhabited by *A. d. distichus*) and northwest and west of Rum Cay and San Salvador (which are inhabited by *A. d. ocior*). I have examined 27 *A. distichus* from Cat Island, of which 14 were freshly taken by Dennis R. Paulson. These lizards I leave unassigned subspecifically, although I doubt that they merit nomenclatorial separation from the balance of the Bahaman subspecies.

In dorsal color and pattern, the Cat Island lizards resemble New Providence *A. d. distichus*. They do not have a green phase and thus are unlike *ocior*, but like *distichus* and *dapsilis*. The dewlap coloration is variable—more so than in any other

Bahaman race; in a single series, Paulson noted that three had pale yellow dewlaps, one had a yellow dewlap with an orange center, and the fifth had an orange dewlap with a narrow yellow edge. Thus, in dewlap color, the Cat Island lizards combine (are intermediate in?) the characters of both *distichus* and *ocior*, on the one hand, and *dapsilis*, on the other.

In the relationships between the interparietal and supraocular semicircles, the Cat Island lizards are not distinctive and resemble both *distichus* and *dapsilis* but not *ocior* (which modally has 1/1 supraorbitals in contact with the interparietal, in contrast to 0/0 or 1/2 in *distichus* and *dapsilis*). The "preoccipital" is absent in six of 24 lizards; this is a higher proportion than *dapsilis*, *distichus* or *ocior*. The mean of median head scales is 4.8, in strong contrast to 6.2 in *dapsilis*, 6.0 in *distichus*, or 5.8 in *ocior*. The postmental mean is 6.0, higher than both *distichus* and *dapsilis*, but lower than *ocior*. The postfrontal contact is bimodal, with both 2/2 and 3/3 having equal frequencies of eight lizards; there is also a strong tendency (as intimated by the bimode of 3/3) for Cat Island lizards to have 3/4 and 4/4 scales in contact laterally with the postfrontals (18 of 26 lizards have three scales in contact unilaterally), whereas counts above 2/3 are relatively uncommon in *distichus* (22 of 128 lizards), *dapsilis* (five of 102 lizards) and *ocior* (six of 59 lizards). Such high lateral postfrontal contact counts are more usually encountered in *biminiensis* (23 of 42 lizards). It should be recalled that 3/3 is the modal condition in *biminiensis*.

On the basis of dewlap color, it would seem appropriate to consider the Cat Island lizards intermediate between *distichus* and *dapsilis*, and the geographic position of Cat Island is in accord with a possibly double "invasion" of lizards from the islands to the northwest and west. I can see no *ocior* influence in the Cat Island lizards. In contrast to the situation with the dewlap color, the scale counts present a peculiar melange of characters which cannot reasonably be attributed to interaction of the two adjacent races. It is probable that Cat Island has been colonized at various times by both *distichus* and *dapsilis*, but that there has been imposed upon these two parent stocks other local differentiation on Cat Island, so that the Cat Island lizards resemble their parent stocks in some characters but have diverged considerably in others.

Specimens examined: BAHAMA ISLANDS. *Cat Island*: Orange Creek, 7 (ASFS V2145–51); Arthur's Town, 7 (MCZ 39580–83, UMMZ 79449); Bennett's Harbour, 4 (AMNH 76337–40); Tea Bay, 2 (ASFS V2159–60); The Bight, 5 (ASFS V2188–91, CM 20444); hills above The Bight, 1 (ASFS V2123); 1 mi. (1.6 km) S McQueen, 1 (AMNH 76336).

Anolis distichus dominicensis Reinhardt and Lütken

Anolis dominicensis Reinhardt and Lütken, 1863, Vid. Medd. Nat. Foren. Kjobenhavn: 261.
Anolis distichus albidogularis Mertens, 1939, Abh. Senckenberg. Naturf. Ges., 449:59.

Type locality: Haiti; restricted to Port-au-Prince, Dépt. de l'Ouest, Haiti.

Definition: A subspecies of *A. distichus* characterized by very large size (males to 58 mm, females to 48 mm snout-vent length), dorsum varying between all green and all dark brown with darker longitudinal striae in all phases, dewlap pale yellow (occasionally white or almost so) to yellow with a faint orange basal blush, modally 1/1 scales between the supraorbital semicircles and the interparietal, 0/0 supraorbitals in contact with the interparietal, 2/2 scales in contact laterally with the postfrontals and moderate mean number (3.9) of median azygous head scales.

Distribution: All of Haiti with the exception of the Tiburon Peninsula west of Miragoâne (precise limits along the southern coast of the Tiburon Peninsula at the longitude of Miragoâne unknown); the República Dominicana in extreme western

Figure 3. Map of Hispaniola, showing distribution of the subspecies of *Anolis distichus*; fine diagonal lines, *A. d. dominicensis*; horizontal lines, *A. d. ignigularis*; diagonal lines, upper right to lower left, *A. d. properus*; open stippling, *A. d. ravitergum*; crosshatching, *A. d. favillarum*; close stippling, *A. d. aurifer*; vertical lines, *A. d. vinosus*; diagonal lines, upper left to lower right, *A. d. suppar*; P, *A. d. patruelis*; J, *A. d. juliae*; T, *A. d. tostus*; S, *A. d. sejunctus*.

Pedernales Province on the south, through extreme western Independencia Province, thence east through San Juan Province to northern La Vega Province (Jarabacoa), Sánchez Ramírez Province (Cotuí), San Cristóbal Province (Gonzalo), and Samaná Province (mouth of the Río Yuna), and north to the northern coast in María Trinidad Sánchez Province (Cabrera), but excluding the Península de Samaná; possibly the Ile de la Tortue off the northern coast of Haiti (Fig. 3).

Comments: *A. d. dominicensis* has the widest distribution of any of the Hispaniolan subspecies. Throughout this wide range, it is remarkably constant in dewlap and dorsal colorations. The dewlap is most often pale yellow (Pl. I), but at times (and not segregated geographically) there is a vague and pale orange basal blush on the otherwise yellow dewlap. Occasional specimens (for example, in the Sierra de Baoruco in Pedernales Province and at Cap-Haïtien in northern Haiti) have the dewlap very pale yellow to practically white.

In the green phase, the ground color is fairly bright and marbled and/or streaked with green, brown, black, or yellow. The head is pale green, and the ventral color varies from pale green to gray or even black. The underside of the tail ranges from bright yellow to yellow-orange. In the brown phase, the back is a rich chocolate or wood brown; some specimens seem incapable of achieving a uniform brown and have a marbled or mottled pattern of darker and lighter browns. There is an intermediate color phase (greenish tan or grayish brown), which presumably is assumed between the definitive green or solid brown conditions.

Scale counts of the series of 245 *A. d. dominicensis* are: snout scales 4 to 10 (mode 4), loreal rows 3 to 7 (mode 4); supraorbital semicircles always in contact; modally 1/1 scales between the semicircles and the interparietal and 0/0 supraorbitals in contact with the interparietal; 2/2 scales in lateral contact with postfrontals; fourth toe lamellae 14 to 24 (mode 19); median azygous head scales 2 to 11 (mode 3, mean 3.9); "preoccipital" almost always present (235 of 251 lizards); postmentals

2 to 12 (modes 6 and 7, mean 6.6). The largest males are from the higher elevations in the Montagne Noire. These elevations (5000 and 5600 feet—1525 and 1708 meters) are among the very highest at which *A. distichus* has been collected. *A. d. dominicensis* also occurs at sea level in many coastal situations, and below sea level in the extreme eastern Cul de Sac Plain.

The specimens from the eastern Cul de Sac Plain are of special interest. In this region (Thomazeau, Manneville), the dorsal coloration is like that of specimens from the uplands on the northern slopes of the Morne l'Hôpital (Pétionville, Morne Calvaire, for instance), but the dewlap color is a deep orange (pl. 4 C 11, pl. 4 G 10 and pl. 4 G 11), at times with a faintly brown cast. This is one of the regions where *A. distichus* is sympatric (but not syntopic) with *A. brevirostris*, which in this same area has an orange dewlap. Of the two species in the Thomazeau-Manneville area, *A. brevirostris* is distinctly the inhabitant of the xeric scrub and *A. distichus* the inhabitant of more mesic situations, oases, and cultivated areas. In this region, *A. brevirostris* is the widespread lizard of open areas, whereas *A. distichus* is restricted to certain less rigorous habitats and is in effect surrounded by *A. brevirostris*. The orange dewlap of *A. distichus* may well be the result of partial or complete isolation of the *A. distichus* populations from the balance of the species. To the east, in the Valle de Neiba in the República Dominicana, *A. d. dominicensis* remains unknown, but is replaced to the east of Lago Enriquillo by the western extreme of another subspecies. Doubtless *A. d. dominicensis* will ultimately be collected between the Dominico-Haitian border and the western end of Lago Enriquillo in the República Dominicana.

Considering the fact that *A. d. dominicensis* occurs at a great variety of elevations, it is obvious that it also occupies a great variety of habitats, from the hot oases in the Cul de Sac Plain to upland mesic cacao groves and rain forest. Cultivated lands are quite suitable, and it is often the dominant anole of shady fence rows and the interior of humid coffee plantings and woods. Along the coast it occurs in mangroves (Trou Forban), mesic and open banana-breadfruit-royal palm associations, on large trees in open cultivated semi-arid regions, and it is common almost everywhere, at least where a minimal patch of shady woods occurs. In the hot and dry Valle de Cibao, *A. d. dominicensis* was encountered in thorn and tree-cactus scrub but in the more shady situations. In short, throughout its broad Hispaniolan range, *A. d. dominicensis* is encountered in almost any situation which offers shade and refuge.

I have noted in the introduction the sleeping habits of *A. d. dominicensis* at Miches and Palo Verde in the República Dominicana. One other observation has been made; two *A. d. dominicensis* were taken sleeping exposed on a large, wet log lying adjacent to a rushing stream, in a deep and cool montane ravine at 2200 feet (671 meters), near Puesto Grande in the Cordillera Septentrional in northern República Dominicana.

I do not regard *A. d. albidogularis* Mertens as a valid subspecies. Mertens was misled into the description of *albidogularis* by the material which he regarded as *dominicensis* from Haiti; his "*dominicensis*" were three males and a female from Gonaïves, and two males and a female from St. Marc. His comments (1939:56) on the distinguishing characters of *A. d. dominicensis* (as based upon these seven specimens) do not apply to *dominicensis*—i.e., that *dominicensis* is never green but rather is gray to gray-brown, has a bright and clear supralabial streak, a pair of dark scapular spots and a lined dorsum, and a chrome-orange-yellow dewlap with citron-yellow scales. These are precisely the characters—especially the always gray color and the pair of scapular spots and a lined dorsum—which distinguish the species *A. brevirostris* from *A. distichus*. It is apparent

that Mertens, when describing *albidogularis*, did not have for comparison specimens of *A. d. dominicensis*, as he presumed, but rather *A. brevirostris*. The characters of *albidogularis* are those of *dominicensis*, and specimens from the vicinity of the type locality (Monte Cristi, República Dominicana) do not differ significantly in any feature from topotypical Port-au-Prince material. The pale dewlap coloration which is ascribed to *albidogularis* is not consistent in the Valle de Cibao population and occurs only sporadically elsewhere; specimens which I have collected near Monte Cristi and in the Valle de Cibao have the dewlap color pale yellow, as do specimens from elsewhere within the range of *A. d. dominicensis*.

A. d. dominicensis differs from all the Bahaman subspecies except *ocior* in having a green phase; the green of *ocior* is a much more yellow-green than the green of *dominicensis*. Of the Bahaman subspecies, all are smaller than *dominicensis; ocior* most closely approaches *dominicensis* in size. The median head scale mean of *dominicensis* (3.9) is lower than that of any Bahaman race (5.5 to 8.7). Only *distichoides* in the Bahamas has the 1/1 scales between the semicircles and the interparietal as does *dominicensis*. Other head scale differences (such as the regular presence of the "preoccipital" and the regular contact between the semicircles in *dominicensis*) are also significantly different in comparison with the Bahaman subspecies.

A. d. dominicensis presumably comes into contact with four other subspecies. In one of these instances (Sierra de Baoruco) no intergradient specimens are known, since there is an hiatus between the closest records of *dominicensis* and this next adjacent form to the east. In three instances, however (*ignigularis*; the subspecies to the west on the Tiburon Peninsula; and the subspecies to the east in the Valle de Neiba), there are samples which I interpret as intermediates. In the case of *ignigularis*, the material from the higher elevations in the eastern portion of the Cordillera Central (vicinity of Constanza, Paso Bajito, etc.) shows the dewlap rather intermediate between the yellow or yellow-with-orange-blush *dominicensis* condition and the solid orange dewlap with a narrow yellow border of *ignigularis*, although the dewlap in general is much closer to that of *ignigularis* than to that of *dominicensis*. I have included these Cordillera specimens with *ignigularis* for that reason.

A small series from Padre las Casas, Azua Province, República Dominicana, I interpret as intergradient between *dominicensis* and the Valle de Neiba-Llanos de Azua subspecies. This lot is closer to the latter race, and I have discussed it in detail there. Finally, lizards from the vicinity of Saint Michel du Sud on the Tiburon Peninsula are intermediate in dewlap color between *dominicensis* and the next adjacent race to the west on the Peninsula (which has a deep orange dewlap with a narrow yellow edge), but they are closer to the latter subspecies, and I have included them in the discussion of that race rather than with *dominicensis*.

I have seen no fresh material from Ile de la Tortue and only three old specimens which are distinctive in neither scutellation nor what is discernible of pattern or pigmentation. I include Tortue in the range of *A. d. dominicensis* only provisionally, since on all other satellite islands where *A. distichus* is found, it is racially distinct. Thus there is a good likelihood that fresh specimens from Tortue will demonstrate that there is a different subspecies present there.

Referred specimens: HAITI. *Dépt. du Sud*: Miragoâne, 30 (MCZ 25489–98 + 20 untagged specimens); Butète, nr. Miragoâne (not mapped), 7 (MCZ 66133–39); Etang Miragoâne, 7 (MCZ 66140–46). *Dépt. de l'Ouest*: 7.1 mi. (11.4 km) E Miragoâne, 1 (ASFS X3850); 3 mi. (4.8 km) W Grand Goâve, 300 feet (92 meters), 1 (ASFS X3856); 1.1 mi. (1.8 km) NE Fauché, 2 (ASFS X2045–46); 5 km S Dufort, 4 (MCZ

63099–102); 4 mi. (6.4 km) SE Léogâne, 4 (ASFS V8463–66); Léogâne, 2 (MCZ 13779–80); Ça Ira, 9 (MCZ 63898–906); bridge over Rivière Momance on road to Léogâne, 1 (MCZ 63103); Mariani, 7 mi. (11.2 km) E Gressier, 7 (ASFS V8446–52); Diquini, 17 (MCZ 59430–32, MCZ 8696–700, MCZ 8703, MCZ 8705, MCZ 8710, MCZ 8712, MCZ 8714–18); Port-au-Prince, 1 (MCZ 51427); Boutillier Road, S of Port-au-Prince, 17 (MCZ 59413–29); SW of Port-au-Prince (not mapped), 1 (MCZ 51258); 2.8 km S Pétionville, 1700 feet (519 meters), 2 (ASFS V8117–18); 5 mi. (8.0 km) NE Pétionville, ca. 160 meters, 3 (ASFS V9405–07); 3 km (airline) W Pétionville, Morne l'Hôpital, 920 meters, 11 (ASFS V8435–45); Morne Calvaire, 1 mi. (1.6 km) SW Pétionville, 2300 feet (702 meters), 44 (ASFS X1237–80); Kenscoff, 2 (MCZ 45745, MCZ 59401); Morne Bourette (not mapped), 2 (MCZ 47546 + one untagged specimen); Peneau, 5000 feet (1525 meters), 4 (ASFS X1350–51, ASFS X1574–75); Furcy, 5600 feet (1708 meters), 45 (ASFS X1591–95, MCZ 63535–39, MCZ 59393–97, MCZ 59433–41); Peneau and Furcy, ca. 4000–5000 feet (1220–1527 meters), 4 (ASFS V4821–44); Hatte Lathan (not mapped), 2 (MCZ 51421–22); Thomazeau, 4 (MCZ 13771–72, MCZ 37455, USNM 59191); near Thomazeau, 2 (MCZ 37495–96); Tète Source, 1.4 km NNE Thomazeau, 3 (ASFS V8173–75); Manneville, 9 (ASFS V8194, CM 38881, MCZ 59390–92, MCZ 63107–10); Ste. Philomène (not mapped), 1 (MCZ 51428); 3.9 mi. (6.2 km) NW Ganthier, 1 (ASFS X2171); Gormand, nr. Saltrou (not mapped), 2 (MCZ 68614–15); Colombier, nr. Saltrou, 4 (MCZ 68616–19); Lan Banane, nr. Saltrou, 5 (MCZ 68620–24); Tète à l'Eau, nr. Saltrou, 6 (MCZ 68625–30); Thiotte, nr. Saltrou, 9 (MCZ 69631–39); Caroye, nr. Saltrou (not mapped), 31 (MCZ 69315–45); Londry, nr. Saltrou (not mapped), 4 (MCZ 69346–49); Citadelle, nr. Saltrou (not mapped), 15 (MCZ 69350–64); Maviete, nr. Saltrou (not mapped), 15 (MCZ 69365–79); Mapou, nr. Saltrou, 7 (MCZ 69380–86); ca. 3.5 mi. (5.6 km) NE Trouin, 800 feet (244 meters), 1 (ASFS V9664); 5 mi. (8.0 km) S Trouin, 700 feet (214 meters), 3 (ASFS V9668–70); Jacmel, 1 (ASFS V9825); ca. 5.5 mi. (8.8 km) NW Jacmel, 600 feet (183 meters), 1 (ASFS V9784); 3 mi. (4.8 km) E Jacmel, 2 (ASFS V9757–58); ca. 1 mi. (1.6 km) W Cayes Jacmel, 4 (ASFS V9700–03); 10 mi. (16.0 km) NNE Marigot, 3200 feet (976 meters), 1 (ASFS V9737); Trou Forban, 1 (ASFS V8216); 1.6 km SW Trianon, 1100 feet (336 meters), 3 (ASFS V8278–80); 1.6 km NE Trianon, 6 (ASFS V8282–87); 7 mi. (11.2 km) N Mirebalais, 1 (ASFS X2234); La Tombe, nr. Mirebalais (not mapped), 21 (MCZ 68204–24); Fer-à-Cheval, nr. Mirebalais, 5 (MCZ 68225–29); Boudou, nr. Mirebalais (not mapped), 13 (MCZ 68230–42); Ledie, nr. Mirebalais (not mapped), 4 (MCZ 68243–46); Dubuisson, nr. Mirebalais (not mapped), 3 (MCZ 68247–49). *Dépt. de l'Artibonite*: south end, Etang Bois Neuf, 1 (MCZ 59942); Pierre Payen, 8 (MCZ 59402–03, MCZ 59407–12); bridge over Rivière de l'Artibonite, St. Marc road, 2 (MCZ 59404–05); Passe Reine, 3 (MCZ 63055–57); 8 to 9 km W Marmelade, 3500 feet (1068 meters), 2 (ASFS V9913–14); 5 mi. (8.0 km) NW St. Michel de l'Atalaye, 4 (ASFS V10030–33); 2 mi. (3.2 km) NW St. Michel de l'Atalaye, 2 (ASFS V10034–35); Hinche, 5 (MCZ 25499–503); Gros Morne, 8 (MCZ 63075–82). *Dépt. du Nord*: 3 mi. (4.8 km) NW Terrier Rouge, 1 (ASFS V10163); Dondon, 10 (MCZ 63063–72); Dondon, southeastern outskirts, 4 (ASFS V10017–20); ca. 2 km S Dondon, 2 (ASFS V10038–39); Grande Rivière du Nord, 13 (MCZ 66655–67); Cap-Haïtien, 94 (MCZ 37483–92 + 69 untagged specimens, MCZ 63058–62, ASFS V10194–204); Ti Guinin, near Cap-Haïtien (not mapped), 8 (MCZ 66668–75); Citadelle Lafèrriere, 7 (MCZ 33370, MCZ 63073–74, MCZ 66651–54); nr. Citadelle Lafèrriere, 2 (MCZ 25487–88); 4 mi. (6.4 km) SSW Limbé, 200 feet (61 meters), 1 (ASFS

V9964); 4 mi. (6.4 km) N Port Margot, east side of Rivière de Port Margot, 1 (ASFS V9971); ca. 2 km inland from Anse à Margot, 1 (ASFS V10277); Chouchou, 10 mi. (16.0 km) NW Port Margot, 6 (ASFS V9978–83); 1 mi. (1.6 km) SW Le Borgne, west side Rivière du Borgne, 2 (ASFS V10001–02); *Dépt. du Nord Ouest*, Jean Rabel, 1 (MCZ 63098); Bombardopolis, 15 (MCZ 63083–97). *Ile de la Tortue*: 3 (MCZ 37493–94, USNM 95121). REPÚBLICA DOMINICANA. *Pedernales Prov.*: 19 km N Pedernales, 1000 feet (305 meters), 1 (ASFS V2702); Las Mercedes, ca. 1400 feet (427 meters), 1 (ASFS V2659); 1 km S Los Arroyos, 4100 feet (1251 meters), 1 (ASFS V2605); 27 km N Puerto de Alcoa, 1 (ASFS X9765). *Independencia Prov.*: Aguacate, 3 (MCZ 58467–69); 8 km E Aguacate, 1600 feet (488 meters), 1 (ASFS X9945); 7.6 km NW La Descubierta, ca. 2000 feet (610 meters), 2 (ASFS V4375–76); Guayabal, 6 km N Postrer Río, 4 (MCZ 58470–73). *San Rafael Prov.*: 18 km SW Hondo Valle, 6000 feet (1830 meters), 1 (ASFS V360); 9.0 mi. (14.4 km) NW Elías Piña, 1 (ASFS V330); Rancho La Guardia, 13 (MCZ 58441–53); Pedro Santana, 1 (MCZ 58440); Bánica, 1 (MCZ 58438); 3 km E Bánica, 1 (MCZ 58439); 3 km NE Bánica, 13 (MCZ 58454–66). *San Juan Prov.*: San Juan, western edge, 6 (ASFS V499–504); 15 km SE San Juan, 4 (ASFS V487–90); 3 km E Las Matas, 4 (ASFS V305–08); Río Arriba del Norte, 1950 feet (595 meters), 3 (ASFS V521–23); 7 km N Carpintero, 9 (MCZ 58500–08); 7 km NW Vallejuelo, 2600 feet (793 meters), 3 (ASFS V302, ASFS V394–95). *La Vega Prov.*: Jarabacoa, 2 (MCZ 58480–81); 3 km NE Jarabacoa, 1 (ASFS V1948). *Sánchez Ramírez Prov.*: 12.3 km E Cotuí, 5 (ASFS V611–15). *San Cristóbal Prov.*: 10 km NE Gonzalo, 600 feet (183 meters), 2 (ASFS V3131–32). *Samaná Prov.*: south side of Río Yuna, approximately 1 km upstream from mouth, 7 (ASFS V2961–67). *María Trinidad Sánchez Prov.*: 11.2 km S Cabrera, 3 (ASFS V4244–46). *Duarte Prov.*: 1 km NW Arensoso, 3 (ASFS V1841–43). *Espaillat Prov.*: 2 km N Puesto Grande, 2200 feet (671 meters), 2 (ASFS V1962–63). *Puerto Plata Prov.*: Puerto Plata, 2 (MCZ 5442, MCZ 43670); Sosúa, 8 (ASFS V1631–32, MCZ 13754–59); 6 km E Imbert, 700 feet (214 meters), 2 (ASFS V1691–92). *Santiago Prov.*: Santiago, 1 (MCZ 58482); Licey al Medio, 4 (MCZ 58317–20); Ceboruco (not mapped), 12 (MCZ 58483–94); 3 km S Pena (not mapped), 5 (MCZ 58495–99); 6 km E El Rubio, 1000 feet (305 meters), 2 (ASFS V2922–23); 7 km SE El Rubio, 2300 feet (702 meters), 1 (ASFS V2924). *Valverde Prov.*: 7 km E Valverde, 2 (ASFS V2954–55). *Monte Cristi Prov.*: 24 km E Monte Cristi, 1 (MCZ 43681); 4 km E Pepillo Salcedo, 1 (ASFS V1167); 2 km NE Palo Verde, 10 (ASFS V1303–12); 1 km S Palo Verde, 4 (ASFS V1357–60). *Dajabón Prov.*: 6 km S Copey, 1 (ASFS V1170); 1 km S Loma de Cabrera, 900 feet (275 meters), 1 (ASFS V1171).

Anolis distichus ignigularis Mertens

Anolis distichus ignigularis Mertens, 1939, Abh. Senckenberg. Naturf. Ges., 449:58.

Type locality: San Pedro de Macorís, San Pedro de Macorís Province, República Dominicana.

Definition: A subspecies of *A. distichus* characterized by moderate size (males to 55 mm, females to 44 mm snout-vent length), dorsum usually green anteriorly and rich and translucent reddish tan posteriorly (but capable of turning completely brown), dewlap vivid orange centrally with a narrow yellow margin, modally 0/0 scales between the supraorbital semicircles and the interparietal, 1/2 supraorbitals in contact with the interparietal, 2/2 scales in contact laterally with the postfrontals, and low mean number (3.5) of median azygous head scales.

Distribution: The República Dominicana from eastern San Cristóbal Province in the west, east along the coast to the type

locality, thence inland to the vicinity of Higüey and to the north coast (east of Miches) in La Romana Province; along the north coast to the Bahía de San Lorenzo in El Seibo Province, south into eastern San Cristóbal Province (Bayaguana), and west into the Cordillera Central; Península de Samaná, west to the vicinity of Yayales (Fig. 3).

Comments: The dewlap and dorsal colors of *A. d. ignigularis* are very constant throughout the range of the subspecies. The vivid and extensive orange center and narrow yellow margin of the dewlap (Pl. I) are diagnostic features of *ignigularis* in the eastern and central portions of the República Dominicana. The dorsum is usually a rather dark green anteriorly, grading rapidly into a translucent reddish tan posteriorly. The lizards can become completely brown, although this brown is of a more reddish shade (cinnamon) than that of *A. d. dominicensis*. The extent of the orange center of the dewlap is slightly variable, but the bright pigment is never restricted to a small and indistinct orange blush, as it is occasionally in *dominicensis*.

Scale data on the series of 103 *A. d. ignigularis* are: snout scales 4 to 8 (mode 4), loreal rows 3 to 6 (mode 5); supraorbital semicircles always in contact; modally 0/0 scales between the semicircles and the interparietal and 1/2 supraorbitals in contact with the interparietal; 2/2 scales in lateral contact with postfrontals; fourth toe lamellae 14 to 22 (mode 20); median azygous head scales 1 to 9 (mode 3, but 4 scales are almost equally as common, mean 3.5); "preoccipital" usually present (100 of 103 lizards); postmentals 4 to 10 (mode 5 or 6, mean 6.0). The asymmetrical mode of 1/2 supraorbitals in contact with the interparietal is peculiar, but the mode is fairly strong (34 individuals; next highest category is 0/0 with 26 lizards). Judging from the high incidence (26) of 1/1 supraorbitals in contact with the interparietal, I suspect that *ignigularis* is a population which is in the process of evolving from a mode of 1/1 to 2/2 but has not completed the transition.

The largest males have snout-vent lengths of 55 mm, and both are from the vicinity of Higüey; the status of that particular population is probably intergradient between *ignigularis* and the race next to the southeast, but these two large males are clearly much more like *ignigularis* than the drab southern form. The largest female *ignigularis* has a snout-vent length of 44 mm; this individual, from the Valle de Culata, at an elevation of 5000 feet (1525 meters) in the Cordillera Central, is from an area of extreme intergradation with *dominicensis*.

A. d. ignigularis is readily separable from all previously discussed subspecies; the combination of orange dewlap and bicolor dorsum occurs in no other form. Comparison with the three orange-dewlapped Bahaman subspecies, *biminiensis*, *distichoides*, and *dapsilis*, is easily made. Aside from these three races lacking the bicolored dorsum, all are smaller, have much higher median head scale means (5.5 to 8.7 in contrast to 3.5 in *ignigularis*), lower means of postmentals (4.6 to 5.2 in contrast to 6.0), and have a high percentage of specimens which lack the "preoccipital." Of the three Bahaman subspecies, only *dapsilis* modally has 0/0 scales between the supraorbitals and the interparietal and 1/2 supraorbitals in contact with the interparietal as does *ignigularis*. In *dapsilis*, however, 1/2 is one of two bimodes. Extended comparisons with *dominicensis* are not necessary; the dewlap and dorsal colorations are sufficient to distinguish the two races. The 1/1 scales between the semicircles and the interparietal and 0/0 supraorbitals in contact with the interparietal in *dominicensis* differ from the conditions of 0 0 and 1 2 in *ignigularis*.

The apparently disjunct range of *ignigularis* is of especial interest. Were it not for the series (seven specimens) from the mouth of the Río Yuna, I would consider that *ignigularis* has a continuous dis-

tribution about the western end of the Bahía de Samaná. However, the Río Yuna lizards are clearly *dominicensis* and have the pale yellow dewlaps of that subspecies. Although there is evidence (Cochran, 1941:2) that the Península de Samaná was in historic time an island separated from the mainland, this seems hardly likely when the isthmus is visited today, since, although it is low-lying and swampy and is bisected by the *canos de Gran Estero*, it is also heavily forested, and it seems doubtful that the Samaná has been completely severed from the mainland so recently. Doubtless the Península has been completely insular at various times in the past. It seems possible that *ignigularis* invaded the Samaná across the Bahía de Samaná from the south, while the former was cut off from the balance of Hispaniola, and became established there, rather than having reached the Península around the western end of the Bahía. Another possibility is that *dominicensis* has followed down the Río Yuna from the interior and has invaded the area at the head of the bay, thereby severing the two components of the *ignigularis* population. Larger numbers of specimens from this immediate area may demonstrate intergradation; the series at hand from the mouth of the Río Yuna, however, does not show it.

Intergradation between *ignigularis* and *dominicensis* occurs in the eastern Cordillera Central, although specimens from the foot of the eastern escarpment of the Cordillera (vicinity of Monseñor Nouel) are clearly *ignigularis*. Specimens from the area about Constanza and Paso Bajito are much like *ignigularis*, except that the dewlap orange is somewhat paler (although usually very extensive), and the dorsum is more regularly all green rather than sharply bicolor. These specimens I regard as closer to *ignigularis* and have so listed them below.

A. d. ignigularis comes into contact with two other subspecies, that to the south and east in the La Romana to Cabo Engaño region, and that to the southwest in the Llanos de Azua. No intergrades are known for the latter contact, and the break between the two subspecies must be rather sharp (see comments below). The four lots of fresh material from the vicinity of Higüey and Bejucal are much closer to *ignigularis* than to the subspecies to the south, although the series from 2 miles south of Higüey has one male with a yellow dewlap without any orange. Taken as a whole, the Higüey and Bejucal material is close to *ignigularis*. In two other areas, the intergrades between these two forms are closer to the unnamed subspecies and will be discussed below.

Like *A. d. dominicensis*, *ignigularis* has a wide altitudinal range, from sea level to elevations of at least 6000 feet (1830 meters) in the Cordillera Central. In the lowlands, it is a customary denizen of moist, shady cacao groves and other wooded situations. In the Cordillera it is encountered most frequently in heavily wooded ravines and local stands of rain forest, although at Valle de Culata it was found on a rail fence in an exposed and abandoned pasture. It does not occur commonly in the pine woods in the highlands.

Specimens examined: REPÚBLICA DOMINICANA. *San Cristóbal Prov.*: 15.5 km SE El Cacao, 1400 feet (427 meters), 1 (ASFS V2463); El Tablazo, nr. Río Nigua, 15 km NW San Cristóbal, 7 (MCZ 58714–20); La Cabirma de la Loma, northwest of San Cristóbal, 4 (MCZ 79269–72); Colonia Ramfis (= La Cabirma de la Loma), 5 (MCZ 58721–22, MCZ 58566–68); 1 km NW Colonia Ramfis (not mapped), 5 (MCZ 58561–65); 3 km SE Colonia Ramfis (not mapped), 7 (MCZ 58569–75); 6 km SE Colonia Ramfis (not mapped), 4 (MCZ 58576–79); 9 km SE Colonia Ramfis (not mapped), 5 (MCZ 58580–84); 12 km SE Colonia Ramfis, 5 (MCZ 58585–89); 15 km SE Colonia Ramfis (not mapped), 3 (MCZ 58590–92); 7 km N San Cristóbal, 6 (MCZ 58593–98); Mt. Calabozo, near San Cristóbal (not mapped), 3 (MCZ 58599–601); 2 mi.

(3.2 km) SE San Cristóbal, 2 (ASFS X7774–75); 3 km W Bayaguana, 4 (ASFS V602–06); 10 km NE Bayaguana, 1 (ASFS V3141); Comate, Municipio Bayaguana, 5 (MCZ 79286–90); Monte Plata, 1 (MCZ 16441). *Distrito Nacional*: 9.8 mi. (15.7 km) E Santo Domingo, 5 (ASFS X7735–39); Santo Domingo, 8 (MCZ 53945, MCZ 58655, MCZ 58708, MCZ 75185–86, MCZ 79266–68). *San Pedro de Macorís Prov.*: 6 km N San Pedro de Macorís, 2 (ASFS X7832–33). *La Romana Prov.*: Bejucal, 5 (MCZ 58602–06); 1 mi. (1.6 km) NE Higüey, 5 (ASFS V771–75); 2 mi. (3.2 km) S Higüey, 4 (ASFS V747–50); 6.6 km W. Higüey, 1 (ASFS V1013); 24.8 mi. (39.7 km) ESE Miches, 2 (ASFS X7891–92). *El Seibo Prov.*: 1.4 mi. (2.2 km) SE Miches, 1 (ASFS X9349); 14 km SW Miches, 8 (MCZ 75187–94); 6.6 mi. (10.6 km) NW Hato Mayor, 2 (ASFS X7871–72); San Francisco, 6 km SE Hato Mayor, 1 (MCZ 58614); 2.1 mi. (3.4 km) N El Valle, 2 (ASFS X7866–67); Sabana de la Mar, 42 (ASFS V3081–98, MCZ 58615–38); 3.5 mi. (5.6 km) S Sabana de la Mar, 7 (ASFS X7841–44, ASFS X7930–32); 20 km S Sabana de la Mar, 11 (MCZ 58639–49); Cueva de Caño Hondo, 5 (ASFS X9284–88); Bahía de San Lorenzo (small beach west of railway bed), 2 (ASFS V3150–51). *La Vega Prov.*: Paso Bajito, 1 (ASFS X8787); 7 km E Paso Bajito, Casa de los Michelenas, 3 (ASFS X8781–83); El Río, 6 (MCZ 64371–76); 7.1 mi. (11.4 km) E El Río, 3500 feet (1068 meters), 1 (ASFS X8112); Constanza, 9 (MCZ 44387, MCZ 58652–54, MCZ 58709–13); 9.1 mi. (14.6 km) N Constanza, 6000 feet (1830 meters), 3 (ASFS X8487, ASFS X8700–01); 9 km N Constanza, 1 (ASFS X8699); 5.1 mi. (8.2 km) N Constanza, Valle de Culata, 5000 feet (1525 meters), 11 (ASFS X8488–98); 6 km W Constanza, 4250 feet (1296 meters), 2 (ASFS X8832–33); Loma Vieja, 1 (MCZ 44383); Paraje La Palma, Municipio Constanza (not mapped), 41 (MCZ 75153–79, MCZ 79273–85); El Convento, Municipio Constanza (not mapped), 5 (MCZ 79291–95); El Montazo, Municipio Constanza (not mapped), 1 (MCZ 79296); Sección La Culata, Paraje La Cienaga, 1 (MCZ 75180); Municipio Jarabacoa, Sección Manabao, Paraje la Cienaga, 3 (MCZ 75181–83); between Constanza and Jarabacoa (not mapped), 5 (MCZ 64383–87); Loma Rucilla, 3 (MCZ 44384–86); Monseñor Nouel, 1 (MCZ 64370); 1.2 mi. (1.9 km) SE Monseñor Nouel, 700 feet (214 meters), 1 (ASFS X8125); Piedra Blanca, 6 (MCZ 64377–82); 2 km NW La Cumbre, 2 (MCZ 56850–51). *Samaná Prov.*: 8 km SE Yayales, 1 (ASFS V1918); 6 km E Sánchez, 2 (ASFS V1908–09); Sánchez, 11 (MCZ 37497–506 + one untagged specimen); 5 km W Samaná, 1 (ASFS V1983); Samaná, 2 (MCZ 5448, MCZ 43699); Puerto Escondido, 4 (ASFS V2974–77).

Anolis distichus properus[5] subsp. n.

Holotype: MCZ 81130, an adult male, from 0.5 mi. (0.8 km) NW Boca de Yuma, La Romana Province, República Dominicana, taken 31 August 1963 by Ronald F. Klinikowski. Original number V920.

Paratypes (all from La Romana Province, República Dominicana): ASFS V921, same data as holotype; ASFS X8235, Río Cumayasa, 17 km W La Romana, 28 June 1963, D. C. Leber; MCZ 16443–51, La Romana, 1922, E. Lieder; MCZ 75203, MCZ 75205–06, La Romana, 27 March 1963, C. E. Ray, R. Allen; MCZ 75184, MCZ 75195–97, 5 km E La Romana, 27 March 1963, C. E. Ray, R. Allen; USNM 157917, 8 km E La Romana, 19 July 1963, R. Thomas; ASFS X9316, 2 km E La Romana, 19 July 1963, R. Thomas; ASFS V1062–63, mouth of Río Chavón, west side, 4 September 1963, R. F. Klinikowski; MCZ 58607, MCZ 58609–13, Sanate, 12 km S Higüey, 26 August 1958, C. E. Ray and A. S. Rand; AMNH 96472–75, 0.3 mi. (0.5 km) NW Boca de Yuma, 29 August 1963, A. Schwartz, R. Thomas; ASFS V1135, 2.5 km NW Boca de Yuma, 4 September 1963, native collector; RT 807, 2.5 km NW Boca

[5] From Latin, *properus*, quick.

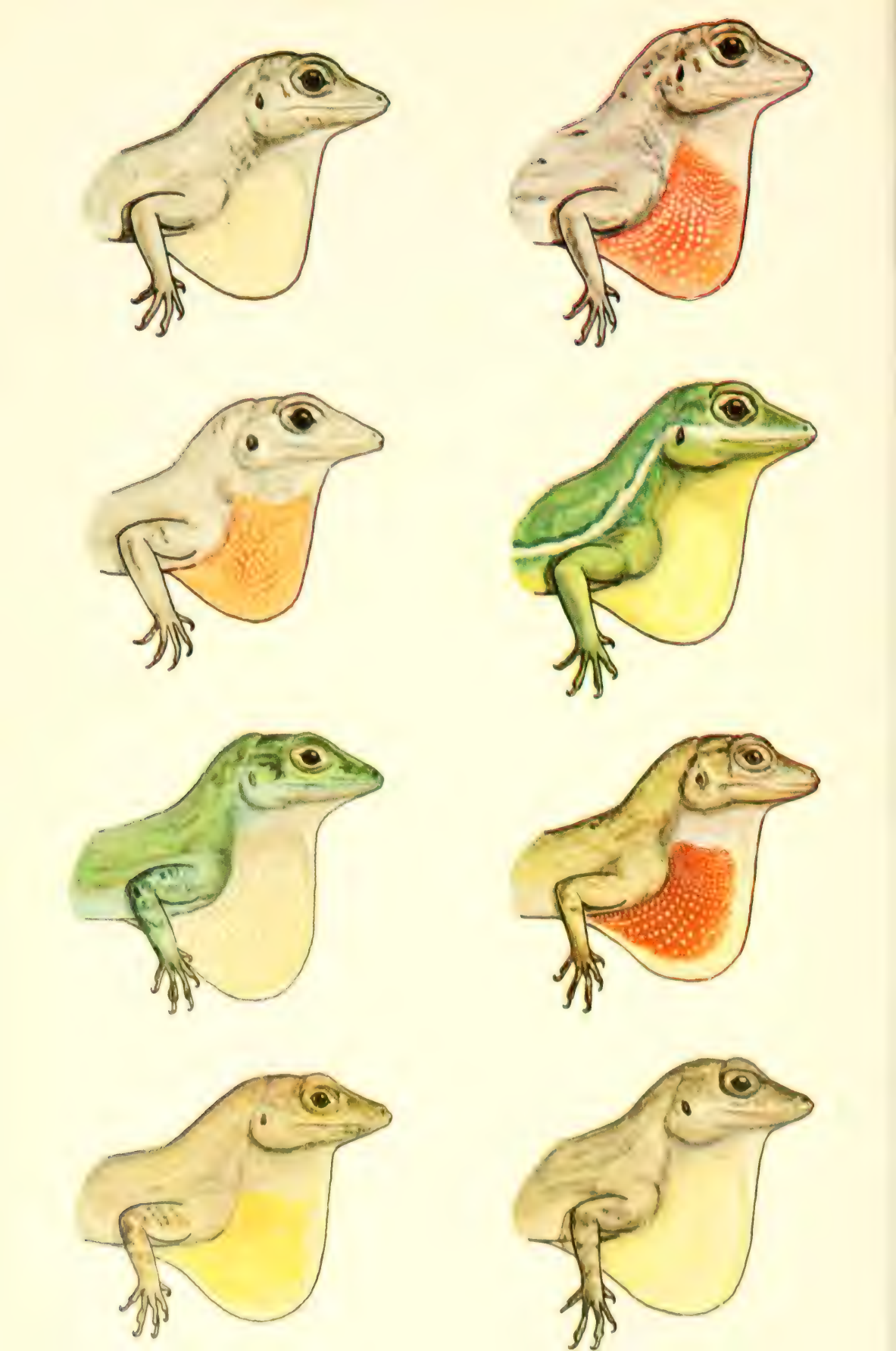


Plate I

First row: *left, A. distichus distichus* (ASFS 10301), Cave Point, New Providence Island, Bahama Islands, snout-vent length 46 mm; *right, Anolis d. distichoides* (ASFS 10280), Fresh Creek, Andros Island, Bahama Islands, snout-vent length 46 mm.

Second row: left, *A. d. biminiensis* (ASFS X4932), western end, South Bimini Island, Bahama Islands, snout-vent length 47 mm; right, *Anolis d. ocior* (MCZ 81140), Port Nelson, Rum Cay, Bahama Islands, snout-vent length 53 mm.

Third row: left, *A. d. dominicensis* (ASFS X1237), Morne Calvaire, 1 mi. SW Pétionville, 2300 feet, Dépt. de l'Ouest, Haiti, snout-vent length 54 mm; right, *A. d. ignigularis* (ASFS X7735), 9.8 mi. E Santo Domingo, Distrito Nacional, República Dominicana, snout-vent length 48 mm.

Fourth row: left, *A. d. properus* (MCZ 81130), 0.5 mi. NW Boca de Yuma, La Romana Province, República Dominicana, snout-vent length 48 mm; right, *A. d. sejunctus* (MCZ 81131), environs of Mano Juan, Isla Saona, República Dominicana, snout-vent length 50 mm.

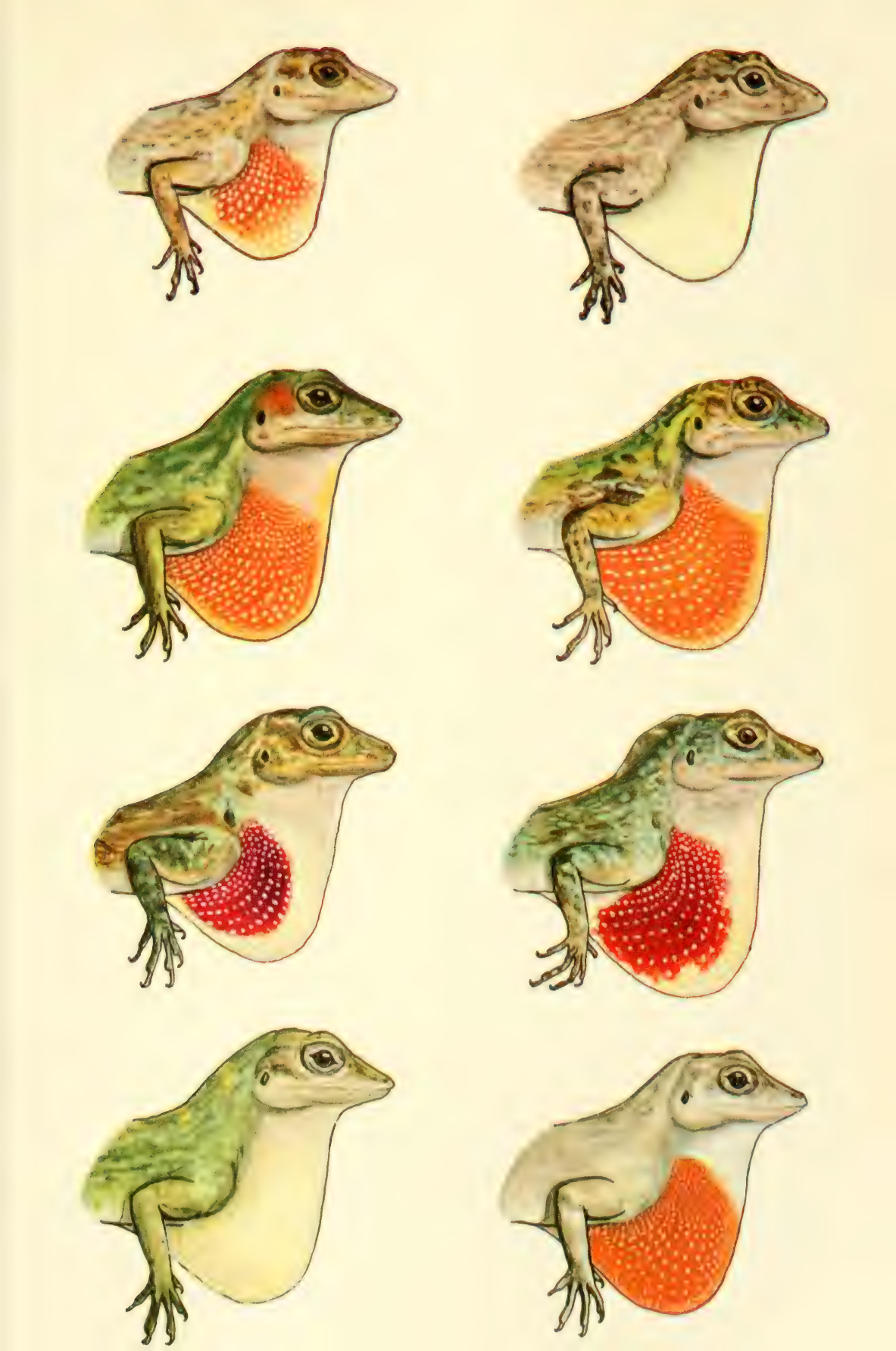
Plate II

First row: left, *A. d. tostus* (MCZ 81134), western end, Isla Catalina, República Dominicana, snout-vent length 49 mm; right, *A. d. ravitergum* (MCZ 81132), 16.5 mi. S San Jose de Ocoa, Peravia Province, República Dominicana, snout-vent length 53 mm.

Second row: left, *A. d. favillarum* (MCZ 81133), 3 km NE Las Auyamas, 3300 feet, Barahona Province, República Dominicana, snout-vent length 50 mm; right, *A. d. aurifer* (MCZ 81135), 11 km N Cavaillon, 1300 feet, Dépt. du Sud, Haiti, snout-vent length 52 mm.

Third row: left, *A. d. vinosus* (MCZ 81136), Camp Perrin, Dépt. du Sud, Haiti, snout-vent length 53 mm; right, *A. d. juliae* (ASFS X3548), western end, Ile-à-Vache, Haiti, snout-vent length 48 mm.

Fourth row: left, *A. d. suppar* (MCZ 81137), Dame-Marie, south side of town along coast, Dépt. du Sud, Haiti, snout-vent length 52 mm; right, *A. d. patruelis* (MCZ 81138), vicinity of Pointe Sable, Ile Grande Cayemite, Haiti, snout-vent length 49 mm.



de Yuma, 6 August 1963, native collector; MCZ 75198–202, Boca de Yuma, 28 March 1963, C. E. Ray, R. Allen; MCZ 75207–21, Juanillo, 29 March 1963, C. E. Ray, R. Allen; UIMNH 61681–83, 16.5 km SE El Macao, 31 August 1963, R. F. Klinikowski, R. Thomas.

Intergrades between *A. d. ignigularis* and *A. d. properus* (but closer to the latter): República Dominicana, La Romana Province: 12 km NE La Romana, 2 (ASFS X9319–20); 0.7 mi. (1.1 km) SE El Macao, 3 (ASFS X7879–81).

Definition: A subspecies of *A. distichus* characterized by moderate size (males to 54 mm, females to 45 mm snout-vent length), dorsum plain ashy to very pale green (rarely) and without any distinct dark markings on the head, dewlap very pale yellow with at times a pale central orange blush, modally 0/0 scales between the supraorbital semicircles and the interparietal and 0/0 supraorbitals in contact with the interparietal, 2/2 scales in contact laterally with the postfrontals, and very low mean number (2.8) of median azygous head scales.

Distribution: La Romana Province, República Dominicana, from the Río Cumayasa on the west, east and north around Cabo Engaño to the vicinity of El Macao; intergrades with *A. d. ignigularis* northeast of La Romana, south of Higüey, and at El Macao (Fig. 3).

Comments: The pale and drab *A. d. properus* stands in strong contrast to its brightly colored relative *ignigularis* to the north and west. The two are readily separable on the basis of body color, since *properus* is always faded and pale and usually ashy gray in the field, although it is capable of a very pale green phase. No specimens were observed to become solid dark brown, one of the phases in the repertory of *ignigularis*. The pale yellow dewlap of *properus* is in harmony with the balance of its faded coloration (Pl. I); occasional specimens have a pale orange central blush on the dewlap. In dewlap color, *properus* resembles *dominicensis* (from whose range it is separated by *ignigularis* and an undescribed subspecies), but it can be differentiated from *dominicensis* by the lack of bright green and dark brown phases. The head is virtually patternless, and this character will differentiate *properus* from the unnamed subspecies to the west in the Valle de Neiba and Llanos de Azua. The hindlimb banding, which is a fairly constant feature of *dominicensis* and *ignigularis*, is much reduced or absent in *properus*.

The holotype has the following measurements and counts: snout-vent length 48 mm, tail ca. 57 mm, tail regenerated; 5 scales across snout, 4 loreal rows, semicircles in contact, 0/0 scales between supraorbital semicircles and interparietal, 1/1 supraorbitals in contact with interparietal, 3/3 scales in lateral contact with postfrontals, 19 fourth toe lamellae, 3 median azygous head scales, "preoccipital" present, 7 postmentals.

Scale counts for the series of 58 *A. d. properus* are: snout scales 4 to 9 (mode 4 but 6 scales is almost equally modal), loreal rows 4 to 6 (mode 5); supraorbital semicircles in contact in all specimens; modally 0/0 scales between supraorbital semicircles and interparietal, and 0/0 supraorbitals in contact with interparietal; 2/2 scales in lateral contact with prefrontals; fourth toe lamellae 15 to 21 (mode 17); median azygous head scales 1 to 6 (mode 3, mean 2.8); "preoccipital" usually present (55 of 58 specimens); postmentals 4 to 11 (mode 6, mean 6.7). The largest male (54 mm snout-vent length) is from La Romana, and the largest female (45 mm) is from 2.5 km NW Boca de Yuma.

Intergradient specimens between *properus* and *ignigularis* from south of Higüey and Bejucal have already been noted under the discussion of the latter subspecies. The Higüey material was collected on fence posts in a shady pasture; in life these lizards were olive to gray with more or less longitudinal dark striae (which *properus*

lacks). One specimen had a dirty yellow dewlap, whereas in the remainder of the series the dewlaps had variable amounts of orange centrally and pale yellow edges. These lizards are appropriate both geographically and in characteristics as intermediates between *properus* and *ignigularis*, but as a whole they are closer to the latter. The Bejucal series, which I did not see in life, at least shows dorsal pattern features which are likewise more like those of *ignigularis* than *properus*.

The specimen from 0.7 mi. (1.1 km) SE El Macao has the dorsum tan and striated. The dewlap has a restricted patch of dull orange basally and a wide pale yellow margin. This specimen, by virtue of its striate dorsum and more prominent orange dewlap blotch, seems intermediate between *properus* and *ignigularis*, although much closer to the former. Specimens of *ignigularis* were taken about 30 kilometers northwest of El Macao.

The remaining locality for *ignigularis* × *properus* intergrades is 12 km NE La Romana. The situation at this locality is most peculiar, since the two specimens were collected in a mesic and forested ravine which presently cuts deeply through cane fields. The dewlap of the single male was dull orange centrally with a narrow dull yellow edge—an *ignigularis* character. The dorsal color was dull grayish to dull greenish; the back was not bicolor and the hues were much subdued and faded, but not so pale as those of *properus*. These specimens combine the characters of *properus* and *ignigularis*.

Comparisons of *properus* with both *dominicensis* and *ignigularis* have been made above. Of the Bahaman subspecies, *properus* most closely resembles *distichus*; from *biminiensis*, *distichoides* and *dapsilis*, *properus* differs in having a yellow rather than an orange dewlap, as well as in several scale characters, the most striking of which is the extremely low mean for median head scales (2.8 in contrast to 5.5 to 8.7 in the above listed Bahaman subspecies). *A. d. ocior* in its non-green phase is somewhat like *properus*, but the longitudinally lined flanks will distinguish the former from the latter, as will also the median head scales (5.8 in *ocior*). From the nominate race, which *properus* most closely resembles in general aspect and dewlap color, *properus* differs in lower mean median head scales (2.8 versus 5.9), greater number of postmentals (6.7 versus 5.4), larger size (54 mm versus 49 mm), and in never having the supraorbital semicircles separated by a row of scales. *A. d. distichus* and *A. d. properus* both have 0/0 scales between the semicircles and the interparietal and 0/0 supraorbitals in contact with the interparietal as the modal conditions.

The range of *A. d. properus* embraces the arid portion of extreme eastern Hispaniola. Lizards were taken on fences and in xeric woods and on rocks with which their color blends exceptionally well. Although I have no data on elevation, there are no high mountains in this southeastern region, and thus no specimens come from elevations of any consequence. The type locality lies on the forested limestone ridge which parallels the coast at Boca de Yuma. At Boca de Chavón, *A. d. properus* was collected in coastal stands of *Coccoloba*. Nowhere does the subspecies appear to be so abundant as *ignigularis* and *dominicensis*.

Anolis distichus sejunctus[6] subsp. n.

Holotype: MCZ 81131, an adult male, from environs of Mano Juan, Isla Saona, República Dominicana, taken 19 July 1964 by Richard Thomas. Original number V3064.

Paratypes: ASFS V3061–63, AMNH 96476, USNM 157918, same data as holotype.

Definition: A subspecies of *A. distichus* characterized by small size (males to 50 mm snout-vent length; only one female known, with snout-vent length of 38 mm),

[6] From Latin, *sejungere*, to sever.

dorsum light gray with darker spots and flecks and suffused with greenish yellow, head without any distinct dark markings, dewlap uniform pale yellow, modally 1/1 scales between the supraorbital semicircles and the interparietal and 0/0 supraorbitals in contact with the interparietal, 2/2 scales in contact laterally with the postfrontals, and moderate mean number (4.3) of median azygous head scales.

Distribution: Isla Saona, República Dominicana (Fig. 3).

Comments: The five males and one female taken on Isla Saona are the only specimens of *A. distichus* known from that island. The dorsum is light gray and (in large males) is suffused with greenish yellow. Thus, *sejunctus* seems to have both a gray and a greenish color phase in its repertory. In both phases, the dorsum is marked with a scattering of dark spots and flecks, although the head lacks any definitive pattern. The dewlap is regularly faint yellow (Pl. 1). The holotype has the following measurements and scale counts: snout-vent length 50 mm, tail 37 mm, two thirds regenerated; 7 scales across snout, 5 loreal rows, semicircles in contact, 0/0 scales between semicircles and interparietal, 1/1 supraorbitals in contact with interparietal, 2/3 scales in lateral contact with postfrontals, 18 fourth toe lamellae, 3 median azygous head scales, "preoccipital" present, 5 postmentals. The series of six *A. d. sejunctus* has the following scale counts: snout scales 5 to 7 (mode 5), loreal rows 4 to 6 (mode 5); supraorbital semicircles in contact in all specimens; modally 1/1 scales between supraorbital semicircles and interparietal and 0/0 supraorbitals in contact with interparietal; 2/2 and 3/3 (each with two specimens) scales in lateral contact with postfrontals; fourth toe lamellae 15 to 18 (mode 18); median azygous head scales 3 to 6 (mode 3 or 5, both with two lizards, mean 4.3); "preoccipital" always present; postmentals 5 to 7 (mode 5, mean 5.7).

A. d. sejunctus resembles *A. d. properus* on the adjacent mainland. Two features distinguish them: the absence in *properus* of any dorsal markings, with a consequently plain back, and the greenish tints which *sejunctus* is apparently able to assume regularly. *A. d. properus* only very rarely has any green hues in its repertory. The two races resemble each other in lacking any dark head pattern, and in having a uniform pale yellow dewlap (although *properus* may have a pale basal orange blush). Scalewise, *properus* modally has 0/0 scales between the semicircles and the interparietal, whereas *sejunctus* has a formula of 1/1. In mean of median head scales, *properus* (2.8) is lower than *sejunctus* (4.3).

From the balance of the subspecies, *sejunctus* differs from *distichoides, biminiensis, dapsilis*, and *ignigularis* in having a yellow rather than an orange dewlap. From the yellow-dewlapped forms *distichus* and *ocior, sejunctus* differs in having 1/1 scales between the semicircles and the interparietal (0/0 in the two Bahaman subspecies) and 0/0 supraorbitals in contact with the interparietal (0/0 in *distichus*, 1/1 in *ocior*). *A. d. distichus* is incapable of a green phase, and the lineate sides and unpatterned back of *ocior* contrast with the patterned back and plain sides of *sejunctus*. The usual differences in presence of the "preoccipital" and higher frequency of complete separation of semicircles in Bahaman versus Hispaniolan races apply as well. Compared with the yellow dewlapped *A. d. dominicensis* to the west, *sejunctus* differs in smaller size, flecked and spotted in contrast to striate dorsum, and lower mean number of postmentals (5.7 versus 6.6). The aspect of these two subspecies is quite different.

The area about Mano Juan is generally shady woody scrub, and the lizards were taken in this habitat as well as in the settlement of Mano Juan.

The fauna of Isla Saona is becoming in-

creasingly well known, and all species which occur there which have been studied (*Leiocephalus lunatus, Ameiva chrysolaema, Ameiva taeniura, Dromicus parvifrons*) are represented by distinctive subspecies, which show expected affinities with their relatives on the adjacent mainland or in extreme eastern Hispaniola. *A. distichus* follows this pattern. Presumably *A. d. sejunctus* is widespread on Saona, despite the fact that it is known only from the area about Mano Juan.

Anolis distichus tostus[7] subsp. n.

Holotype: MCZ 81134, an adult male, from Isla Catalina, western end, República Dominicana, taken 20 August 1963 by Richard Thomas. Original number V558.

Paratypes: ASFS V559–60, same data as holotype.

Definition: A subspecies of *A. distichus* characterized by (presumably) small size (males to 46 mm snout-vent length; females unknown), dorsum yellow-tan with little or no flecking or striations and no head pattern, dewlap deep orange centrally with a yellow border, modally 0/0 scales between the supraorbital semicircles and the interparietal, and moderate mean number (5.0) of median azygous head scales.

Distribution: Isla Catalina, República Dominicana (Fig. 3).

Comments: The three male specimens of *A. d. tostus* are so distinctive that I have no hesitancy in describing them as a subspecies which differs both from *properus* on the adjacent coast and *sejunctus* on Isla Saona to the east. The yellow-tan dorsum (pl. 12 J 3) is like that of no other subspecies of *A. distichus*; the patternless head resembles that of both *sejunctus* and *properus*, but the extensively orange-centered dewlap (Pl. II) is more like that of *ignigularis* (which usually has the orange center larger and the yellow edge much narrower) than the pale yellow dewlaps of both *properus* and *sejunctus*. There is no evidence (but the number of specimens both collected and observed was few) that *tostus* has a green phase or has green pigment in its repertory.

The holotype has the following measurements and counts: snout-vent length 46 mm, tail broken; 5 scales across snout, 5 loreal rows, semicircles in contact, 0/0 scales between semicircles and interparietal, 2/2 supraorbitals in contact with interparietal, 2/2 scales in lateral contact with postfrontals, 16 fourth toe lamellae, 5 median azygous head scales, "preoccipital" present but tiny, 4 postmentals. The series of three *A. d. tostus* has the following scale counts: snout scales 5 and 6 (mode 6), loreal rows 4 and 5 (mode 4); supraorbital semicircles in contact in all specimens; modally 0/0 scales between supraorbital semicircles and interparietal; no mode for number of supraorbitals in contact with interparietal—counts of 1/1, 2/0, 2/2; no mode for number of scales in lateral contact with postfrontals—counts of 2/2, 2/3, 3/3; fourth toe lamellae 16 to 19 (mode 16); median azygous head scales 4 to 6 (no mode; mean 5.0); "preoccipital" always present; postmentals 3 and 4 (mode 4, mean 3.7). The mean of median head scales is the highest for any Hispaniolan population; the small sample of *tostus* renders the significance of this high figure dubious.

From the subspecies *distichus, ocior, dominicensis, properus,* and *sejunctus, A. d. tostus* differs in having a yellow-tan dorsum and a dewlap with a deep orange center and a broad yellow edge. It resembles the races *biminiensis, distichoides, dapsilis,* and *ignigularis* in having an orange dewlap, but differs from these races in dorsal color and pattern. Scale counts are not profitably compared.

On Isla Catalina, *A. d. tostus* was collected exclusively in dry hammock woods (= low coppice), and even there was uncommon. Since Isla Catalina is very dry and much of it is sun-baked scrub and grassland, presumably *tostus* is restricted to the shadier situations in xeric woods.

[7] From Latin, *torrere*, to parch.

Anolis distichus ravitergum[8] subsp. n.

Holotype: MCZ 81132, an adult male, from 16.5 mi. (26.4 km) S San José de Ocoa, 500 feet (122 meters), Peravia Province, República Dominicana, one of a series taken 24 August 1963 by Ronald F. Klinikowski, Albert Schwartz, and Richard Thomas. Original number V728.

Paratypes (all from the República Dominicana): ASFS V729–35, same data as holotype; ASFS X7988, 1.8 mi. (2.9 km) W, thence 1.1 mi. (1.8 km) N Azua, Azua Province, 24 June 1963, R. Thomas; AMNH 96477–80, CM 40604–08, 1.8 mi. (2.9 km) W, thence 2.7 mi. (4.3 km) N Azua, Azua Province, 24 June 1963, R. F. Klinikowski, D. C. Leber; MCZ 58422–23, 12 km N Azua, Azua Province, 11 August 1958, C. E. Ray, A. S. Rand; ASFS V3169–77, 2 km W Puerto Viejo, Azua Province, 27 July 1964, D. C. Leber, R. Thomas; UIMNH 61684–85, 15.2 mi. (24.3 km) S San José de Ocoa, Peravia Province, 24 August 1963, A. Schwartz; UF/FSM 21514–15, 1.8 mi. (2.9 km) S San José de Ocoa, 1300 feet (397 meters), Peravia Province, 24 August 1963, R. F. Klinikowski, R. Thomas; USNM 157919–25, 10 km W Baní, Peravia Province, 27 July 1964, D. C. Leber, R. Thomas; MCZ 58421, 13 km NW Baní, Peravia Province, 6 August 1958, C. E. Ray, A. S. Rand; KU 93359–64, 4.2 mi. (6.7 km) NE Sabana Grande de Palenque, San Cristóbal Province, 27 June 1963, A. Schwartz.

Referred specimens: REPÚBLICA DOMINICANA. *Independencia Prov.*: 6.3 mi. (10.1 km) SW Neiba, 3 (ASFS V269–71). *Baoruco Prov.*: 3.9 mi. (6.2 km) ENE Neiba, 4 (ASFS V221–24); 3.4 mi. (5.4 km) ENE Neiba, 1 (ASFS V246); 0.8 mi. (1.3 km) SW Neiba, 4 (ASFS V248–50, RT 774).

Intergrades between *A. d. ravitergum* and *A. d. dominicensis*: REPÚBLICA DOMINICANA. *Azua Prov.*: Padre las Casas, 3 (MCZ 58477–79).

Definition: A subspecies of *A. distichus* characterized by large size (males to 56 mm, females to 45 mm snout-vent length), dorsum ashy gray to tan or pale greenish, head usually with a distinct interocular dark brown bar and a dark U extending from the eyes across the occiput, dewlap pale yellow, at times with a faintly orange center, modally 0/0 scales between the supraorbital semicircles and the interparietal and 1/1 supraorbitals in contact with the interparietal, 2/2 scales in contact laterally with the postfrontals, and a very low mean number (2.6) of median azygous head scales.

Distribution: The Valle de Neiba and the Llanos de Azua, from east of Lago Enriquillo east to the vicinity of Sabana Grande de Palenque in San Cristóbal Province, República Dominicana (Fig. 3).

Comments: *A. d. ravitergum* is typically an ashy gray to drab tan lizard with a fairly prominent brown head pattern. Some individuals show a greenish phase, but the green is neither bright nor vivid. The dewlap is pale yellow and occasionally has a pale orange center (Pl. II). Specimens with orange-centered dewlaps are commoner in the Valle de Neiba and may be demonstrating in this area the residual genetic influence of the subspecies in the uplands of the adjacent Sierra de Baoruco. The back is usually moderately marked with vague longitudinal striae, but some specimens are plain above. A few lizards (as preserved) lack the head markings described for the subspecies, but in general the markings are a consistent feature of the entire series. The venters are whitish and the undersides of the tails vary from pale yellow to orange or yellowish green. In general, the entire coloration is faded and subdued.

The holotype has the following measurements and counts: snout-vent length 53 mm, tail 56 mm, incomplete; 4 scales across snout, 5 loreal rows, semicircles in contact, 0/0 scales between supraorbital semicircles and interparietal, 1/2 supraorbitals in contact with interparietal, 2/2 scales in lateral

[8] From Latin, *ravum*, gray, and *tergum*, back.

contact with postfrontals, 19 fourth toe lamellae, 2 median head scales, "preoccipital" present but divided longitudinally, 6 postmentals.

Scale counts for the series of 57 *ravitergum* are: snout scales 4 to 8 (mode 6), loreal rows 3 to 6 (mode 4); supraorbital semicircles in contact in all specimens; modally 0/0 scales between supraorbital semicircles and interparietal and 1/1 supraorbitals in contact with interparietal; 2/2 scales in lateral contact with postfrontals; fourth toe lamellae 14 to 23 (mode 17); median azygous head scales 0 to 5 (mode 3, mean 2.6); "preoccipital" usually present (49 of 52 specimens); postmentals 4 to 9 (mode 5, mean 5.6). The largest males (56 mm) are from 3.9 mi. (6.2 km) ENE Neiba, Baoruco Province, and the largest female (45 mm) is from 12 km E Azua, Azua Province.

In having a yellow dewlap, *ravitergum* differs from the orange-dewlapped subspecies *biminiensis*, *distichoides*, *dapsilis*, *ignigularis* and *tostus*. *A. d. ravitergum* in its drab coloration is most like *properus* and *sejunctus*. The presence of a head pattern and of at least vague striae on the dorsum will distinguish *ravitergum* from these races. From *dominicensis*, *ravitergum* differs in dorsal coloration (lacking either a bright green or a dark brown phase), in having 0/0 scales between the semicircles and the interparietals and 1/1 supraorbitals in contact with the interparietal (1/1 and 0/0, respectively, in *dominicensis*), and lower mean number of median head scales (2.6 versus 3.9). *A. d. ravitergum* resembles *A. d. ocior* in general dorsal color, but the latter race has a prominent lateral pale streak, a brighter green phase, and much higher mean of median head scales (2.6 versus 5.8). *A. d. ravitergum* is the second largest subspecies, being exceeded in snout-vent length only by *A. d. dominicensis*. It is most closely approached by *ignigularis* and *properus* in size.

Presumably *A. d. ravitergum* comes into contact with three other subspecies of *A. distichus*. To the west in the Valle de Neiba it must meet *dominicensis* somewhere between Neiba, on the one hand, and Aguacate and the mountains above La Descubierta, on the other. No specimens are available from this hiatus, and it is interesting that the lizards from both the latter localities are from the ascending slopes of the Sierra de Neiba (2000 feet—610 meters) and the Sierra de Baoruco (1600 feet—488 meters). Since *ravitergum* is in essence an inhabitant of the floor of the Valle de Neiba in the western portion of its range, the zone of intergradation may well be narrow and restricted to the lower slopes of the ranges. The nearest localities in the valley floor whence I have seen *A. d. dominicensis* to the west in Haiti are Manneville and Thomazeau; comment on the orange-dewlapped populations of *dominicensis* in the Thomazeau-Manneville region has already been made. It is pertinent to note again that the highest frequency of orange dewlap centers in *ravitergum* is in the Valle de Neiba east of the Thomazeau-Manneville area.

A short series of three specimens is from Padre las Casas, Azua Province, on the southern dry slopes of the Cordillera Central. These lizards, even though preserved for some time, still are noticeably green, especially about the head; the larger female has a snout-vent length of 47 mm, which is near the upper extreme of female *dominicensis* but below that of *ravitergum*. The general area about Padre las Casas is transitional between the lower arid Llanos de Azua and the more mesic interior uplands, but its aspect and fauna (i.e., *Ameiva lineolata*) are closer to those of the hot lowlands. I would expect on ecological grounds that the *A. distichus* at Padre las Casas would be *ravitergum*; geographically, however, it is an almost ideal situation for intergradation between a lowland and (in this area) highland subspecies.

A. d. ravitergum comes into contact in the east with *A. d. ignigularis*, in southwestern San Cristóbal Province. Here, the

line of demarcation between the two subspecies is extremely sharp, since *ravitergum* is known from 4.2 mi. (6.7 km) NE Sabana Grande de Palenque and *ignigularis* from 2 mi. (3.2 km) SE San Cristóbal and 15.5 km SE El Cacao at 1400 feet, as well as from a series of specimens from various measured localities along the road from San Cristóbal to El Cacao. The *ignigularis* localities are distinctly upland and mesic, although the locality southeast of San Cristóbal is in the mesic lowlands. The distance between the San Cristóbal and Sabana Grande localities is about 16 kilometers airline, but the situation near San Cristóbal (a shaded fence row adjacent to pasture in a generally mesic region) is in contrast to the drier coastal region near Sabana Grande. In general, this area in the vicinity of Baní is becoming increasingly well known as either a place where there is fairly rapid shift in subspecies or as the extreme limit of distribution of species, since on the west are the xeric Llanos de Azua and on the east the more mesic regions which extend toward Santo Domingo. The specimens which I have examined from this general region are referable to either *ravitergum* or *ignigularis*, and I do not regard any of them as intergradient.

There is presumably also a zone of contact between *ravitergum* and the undescribed subspecies in the Sierra de Baoruco, but there are no specimens from lower intermediate elevations, and all material at hand from the eastern Baoruco is clearly the race indigenous to that massif and shows no tendencies toward *ravitergum* (see however the discussion below concerning the material from southwest of Barahona in the Sierra de Baoruco).

Although *A. d. ravitergum* is essentially a lowland subspecies in the Valle de Neiba and the Llanos de Azua, it does ascend the southern rolling piedmont of the Cordillera Central in the vicinity of San José de Ocoa and also occurs in the Sierra de Ocoa. But in both these regions, conditions are xeric and merely continuations of the same habitat in the lower plains. The highest elevation for *A. d. ravitergum* is 1300 feet (397 meters); presumably it also occurs below sea level at the eastern end of Lago Enriquillo.

The relationships of *A. d. ravitergum* and *A. brevirostris* in the Valle de Neiba will be discussed later in detail by Dr. Williams. It is pertinent at this time to point out that in this low and arid valley, *A. d. ravitergum* is more or less confined to shady palm oases and other less rigorous situations, whereas *A. brevirostris* is the lizard of the open scrub. On the ascending slopes of the Sierra de Baoruco, *A. distichus* and *A. brevirostris* are precisely syntopic; in this area of syntopy, the vegetational cover is intermediate between that of the rain forest above and the arid plains below.

Anolis distichus favillarum[9] subsp. n.

Holotype: MCZ 81133, an adult male, from 3 km N Las Auyamas, 3300 feet (1007 meters) Barahona Province, República Dominicana, taken 24 July 1963 by David C. Leber. Original number X9593.

Paratypes (all from Barahona Province, República Dominicana): ASFS X9592, same data as holotype; ASFS X9838–41, 7.0 mi. (11.2 km) S Cabral, 2300 feet (702 meters), 27 July 1963, R. Thomas; CM 40609–12, 7.1 mi. (11.4 km) S Cabral, 2300 feet (702 meters), 27 July 1963, D. C. Leber, R. Thomas; ASFS X9832–33, 8.8 mi. (14.1 km) S Cabral, 2700 feet (824 meters), 27 July 1963, D. C. Leber, R. Thomas; MCZ 58424, MCZ 58426–28, MCZ 58430–31, MCZ 58433–35, MCZ 58437, La Cueva, 11 km SW Cabral, 17 August 1963, C. E. Ray, A. S. Rand; UF/FSM 21516, 8 km NE Las Auyamas, 2600 feet (793 meters), 28 July 1963, native collector; UF/FSM 21517, 24 km SW Barahona, 3700 feet (1129 meters), 2 August 1963, D. C. Leber; AMNH 96481–83, 24 km SW Barahona, 3700 feet (1129 meters), 6 July 1964, D. C.

[9] From Latin, *favilla*, glowing ashes.

Leber, R. Thomas; MCZ 65353, Hermann's finca, near Paraíso, 2400 feet (732 meters), 26 August 1932, W. G. Hassler.

Definition: A subspecies of *A. distichus* characterized by moderate size (males to 54 mm, females to 47 mm snout-vent length), dorsum bright dark green and heavily striate with darker green or brownish, head with rusty temples and interparietal scale yellow-green and sharply set off from remainder of green head coloration, dewlap vivid orange centrally with a narrow pale yellow edge, modally 1/1 scales between the supraorbital semicircles and the interparietal and 0/0 supraorbitals in contact with the interparietal, 2/2 scales in contact laterally with the postfrontals, and a moderate mean number (3.8) of median azygous head scales.

Distribution: Known only from intermediate and higher elevations in the eastern portion of the Sierra de Baoruco in the República Dominicana (Fig. 3).

Comments: Perhaps the most gaudy of the Hispaniolan mainland races of *A distichus* is *favillarum*. This is especially true when it is compared with its neighbors *dominicensis* in the west and *ravitergum* in the north. The latter is essentially a drab brownish lizard with a pale yellow dewlap and the former a green lizard with a pale yellow dewlap. Neither has the rusty temples and sharply distinct yellow-green interparietal scale nor the vivid orange *favillarum* dewlap (Pl. II).

The holotype of *A. d. favillarum* has the following measurements and counts: snout-vent length 50 mm, tail broken; 4 scales across snout, 4 loreal rows, semicircles in contact, 0/0 scales between supraorbital semicircles and interparietal, 2/2 supraorbitals in contact with interparietal, scales in lateral contact with postfrontals indeterminate, 21 fourth toe lamellae, 1 median head scale, "preoccipital" absent, 5 postmentals.

The series of 28 *A. d. favillarum* has the following counts: snout scales 3 to 6 (mode 4), loreal rows 4 to 6 (mode 4); supraorbital semicircles in contact in all specimens; modally 1/1 scales between supraorbital semicircles and interparietal and 0/0 supraorbitals in contact with interparietal; 2/2 scales in lateral contact with postfrontals; fourth toe lamellae 16 to 22 (mode 19); median azygous head scales 1 to 6 (mode 4, mean 3.8); "preoccipital" usually present (26 of 28 specimens); postmentals 4 to 8 (mode 7, mean 6.1).

In having an orange dewlap, *favillarum* differs from the subspecies *distichus, ocior, dominicensis, properus, sejunctus,* and *ravitergum*. Although in dewlap color *A. d. favillarum* resembles *biminiensis, distichoides, dapsilis, ignigularis,* and *tostus,* none of these races is deep bright green above with rusty temples and a distinct yellow-green parietal. Despite the dewlap similarities, for instance, it is hard to visualize two subspecies more distinct in general appearance than *favillarum* and *tostus*, or *favillarum* and *biminensis*. In having 1/1 scales between the semicircles and the interparietal and 0/0 supraorbitals in contact with the interparietal, *favillarum* resembles *distichoides, dominicensis,* and *sejunctus*. The moderate mean of median head scales (3.8) in *favillarum* is lower than those of the other orange-dewlapped races (5.0 to 8.7) with the exception of *ignigularis* (3.5).

In some ways *favillarum* most closely resembles *ignigularis,* but these two subspecies can be differentiated in that *favillarum* lacks the bicolor dorsum of *ignigularis,* and *ignigularus* lacks the rusty temples of *favillarum*. The ranges of the two are separated by some 62 kilometers at their nearest points (and the distance is longer if one considers the intervening coastal embayments and irregularities) as well as by the intervening lowland subspecies *ravitergum* in the Llanos de Azua. *A. d. favillarum* is so distinctive in color and pattern that it really requires little detailed comparison with any other subspecies.

A. d. favillarum presumably comes into contact with *ravitergum* to the north at the base of the Sierra de Baoruco and with

dominicensis to the west in the western portion of the Sierra de Baoruco. The lack of *favillarum* × *ravitergum* intergrades has been explained in the discussion of the latter subspecies. The absence of *favillarum* × *dominicenses* intergrades is doubtless due to the fact that there is no material available from the central (and virtually inaccessible) portion of the Sierra de Baoruco. *A. distichus* from the Sierra de Baoruco along the Dominico-Haitian border are *dominicensis*. One of the paratypes of *A. d. favillarum* is of possible interest insofar as the problem of intergradation between this subspecies and *ravitergum* is concerned. This adult lizard, from 24 km SW Barahona at an elevation of 3700 feet (1129 meters), was noted as having a plain yellow dewlap. The specimen might be interpreted as showing tendencies toward the *ravitergum* dewlap condition; on the other hand, this seems unlikely, especially in view of the extreme elevation of the locality. I consider it more likely that it is simply a *favillarum* with an aberrantly colored dewlap.

A. d. favillarum is esentially a denizen of mesic woods and *cafetales* at higher elevations in the Sierra de Baoruco; the known altitudinal limits for the subspecies are from 2300 feet (702 meters) to 3700 feet (1129 meters), although the subspecies must occur at both higher and somewhat lower elevations in this mountain range. In the area of syntopy with *A. brevirostris* (the lower altitudinal limits noted above), the vegetational cover is transitional between that of the very mesic uplands and that of the Valle de Neiba below.

Anolis distichus aurifer[10] subsp. n.

Holotype: MCZ 81135, an adult male, from 11 km N Cavaillon, 1300 feet (397 meters), Dépt. du Sud, Haiti, one of a series taken 6 August 1962 by Dennis R. Paulson, David C. Leber, and native collectors. Original number X3717.

Paratypes (all from Dépt. du Sud, Haiti): ASFS X3658–63, ASFS X3680–84, ASFS X3718–23, AMNH 96484–87, KU 93365–68, CM 40613–16, UIMNH 61686–89, same data as holotype; MCZ 74838–64, Pourcine, Massif de la Hotte, 31 December 1962—2 January 1963, F. Vuilleumier; MCZ 74833–37, Trou Bois on Jérémie Road, 30 December 1962, D. Hill.

Referred specimens: HAITI. *Dépt. du Sud*: Tosia, 1 (MCZ 69756); nr. Massif de la Hotte (= Pic Macaya), 3 (MCZ 38254–56); Petit Trou de Nippes, 8 (USNM 80801–08).

Definition: A subspecies of *A. distichus* characterized by moderate size (males to 54 mm, females to 46 mm snout-vent length), dorsum heavily marbled with varying shades of greens and browns, dewlap vivid orange with a narrow yellow border, modally 1/1 scales between the supraorbital semicircles and the interparietal and 0/0 supraorbitals in contact with the interparietal, 2/2 scales in contact laterally with the postfrontals, and a moderate mean number (3.7) of median azygous head scales.

Distribution: Known definitely from only three localities (the type locality, Pourcine, and Trou Bois) on the north and south flanks of the Massif de la Hotte on the Tiburon Peninsula in southwestern Haiti; by inference and observation (see below) assumed to occur from southeast of Jérémie east to the vicinity of Saint Michel du Sud, where *aurifer* intergrades with *dominicensis* (Fig. 3).

Comments: The Tiburon Peninsula of Haiti, west of about the longitude of Miragoâne on the north coast and a presently unknown locality on the south coast, is inhabited by a complex of (at least) three subspecies of *A. distichus*. In addition to these three mainland races, there are additional subspecies on Ile-à-Vache off the south coast and Ile Grande Cayemite off the north coast. The three mainland subspecies are very different in dewlap color in life, but the dewlap colors and

[10] From Latin, *aurifer*, gold bearing.

pattern are of course fugitive in preserved material. Consequently, the precise boundaries of the various races can be defined only in terms of freshly collected specimens, and many older specimens from this region may be placed with a particular subspecies only if there are adequate field data on color in life—which in some critical material there are not. Questionable subspecific assignments will be noted in appropriate discussions.

The series of *A. d. aurifer* from the type locality was examined by me in life. These lizards were heavily mottled and streaked above with varying shades of greens and browns, but lacked any bright colors (i.e., rusty temples) on the head or body. The dewlap was vivid orange with a narrow yellow margin (Pl. II); some males had the dewlap orange-red, a still more distinctive and vivid color. The series from Pourcine in the Museum of Comparative Zoology was noted by the collector to have the dewlaps orange "with yellow spots in the orange"—this latter a feature not seen in the topotypical series. The Trou Bois lizards were likewise noted to have "brilliant orange-red" throats. Richard Thomas collected a single male *A. distichus* about 7.5 km (airline) south-southeast of Roseaux which also had an orange dewlap, but the lizard escaped. These localities summarize the *known* distribution of orange-dewlapped *A. distichus* in this region. I have included the single lizard from Tosia, three from Pic Macaya, and eight from Petit Trou de Nippes with *aurifer* on the basis of provenance. Tosia is on the Les Cayes-Jérémie road on the north side of the Massif de la Hotte, and the lizard might be assigned to the Les Cayes-Camp Perrin subspecies described below. However, there are no known specimens of the more southern race from the north slope of the La Hotte, and it seems likely that the specimen is an *aurifer*. The same comments apply equally well to the Pic Macaya lizards. The series from Petit Trou de Nippes falls into the same category, since there are no fresh specimens from the northern coast of the Tiburon Peninsula in this region.

The measurements and counts of the holotype of *A. d. aurifer* are: snout-vent length 52 mm, tail ca. 70 mm; 6 scales across snout, 5 loreal rows, semicircles in contact, 1/1 scales between supraorbital semicircles and interparietal, 0/0 supraorbitals in contact with interparietal, 2/2 scales in lateral contact with postfrontals, 20 fourth toe lamellae, 4 median head scales, "preoccipital" present, 6 postmentals.

The series of 67 *A. d. aurifer* has the following counts: snout scales 4 to 7 (mode 4), loreal rows 3 to 6 (mode 4); supraorbital semicircles in contact in all specimens; modally 1/1 scales between supraorbital semicircles and interparietal and 0/0 supraorbitals in contact with interparietal; 2/2 scales in lateral contact with postfrontals; fourth toe lamellae 16 to 23 (mode 19, but 20 has almost the same frequency); median azygous head scales 1 to 7 (mode 3, mean 3.7); "preoccipital" always present; postmentals 4 to 10 (mode 7, mean 7.2).

The orange dewlap of *A. d. aurifer* differentiates the subspecies from the yellow-dewlapped races *distichus*, *ocior*, *dominicensis*, *properus*, *sejunctus*, and *ravitergum*. In addition to dewlap and dorsal color and pattern (none of the above subspecies has a heavily mottled green-and-brown back), *aurifer* differs in the high mean number of postmentals (7.2 in *aurifer*, 5.4 to 6.7 in the above races, with *ocior* approaching *aurifer* most closely). The other orange-dewlapped subspecies are *biminiensis*, *distichoides*, *dapsilis*, *ignigularis*, *tostus*, and *favillarum*, of which *aurifer* is closest geographically to *favillarum*, but from which it is separated by the intervening range of *dominicensis*. All these subspecies differ in dorsal pattern and color from *aurifer* (in fact, only *favillarum* has a green phase); the rusty temples of *favillarum* additionally distinguish it from *aurifer*. The mean postmentals of *aurifer*

(7.2) aid in separating it from the other orange-dewlapped subspecies (3.7 to 6.1, with *favillarum* approaching *aurifer* most closely).

A. d. aurifer is presumed to intergrade with *A. d. dominicensis* in the vicinity of Saint Michel du Sud, southwest of Miragoâne. A series of 18 specimens (ASFS X3830–47) from 3.5 mi. SW Saint Michel du Sud, 1000 feet (305 meters), was noted as having the dewlaps pale orange with a yellow edge—precisely the condition expected at the place of intergradation of an orange-dewlapped and a yellow-dewlapped race. Purely on the basis of provenance, I consider two other lots of specimens from this same region (MCZ 66113–32, Fond des Nègres, and MCZ 25504–08, 10 mi. [16.0 km] SW Miragoâne) *aurifer* × *dominicensis*. The latter lot may be assignable to *A. d. dominicensis*, but the Fond des Nègres series is close to Saint Michel du Sud, the known locality for *aurifer* × *dominicensis* intergradation. Other than these intergrades, the eastern limits of *aurifer* are unknown; specimens from the north coast in the Miragoâne region were clearly *dominicensis* in life.

In the northwest *aurifer* intergrades with the yellow-dewlapped population on the tip of the Tiburon Peninsula in the area about Roseaux, and in the south *aurifer* intergrades with another subspecies in the vicinity of Cavaillon. In both cases, these intergrades will be discussed with their respective subspecies.

The distribution herein attributed to *A. d. aurifer* is indeed most peculiar, since it is assumed to occur on both sides of at least the eastern portion of the Massif de la Hotte, and along a portion of the north coast as well. Much of the upland range assigned to *aurifer* is extremely difficult to penetrate, and it may be some time before the details of the distribution of *aurifer* are clarified. On the basis of the few annotated series presently available, there is no choice but to regard all these specimens as one subspecies.

The type locality of *A. d. aurifer* is a rocky shaded hillside on the southern slopes of the Massif de la Hotte.

Anolis distichus vinosus[11] subsp. n.

Holotype: MCZ 81136, an adult male, from Camp Perrin, Dépt. du Sud, Haiti, one of a series taken 22 July 1962 by native collectors. Original number X2711.

Paratypes (all from Dépt. du Sud, Haiti): ASFS X2533–49, ASFS X2560–70, AMNH 96488–97, UIMNH 61690–95, CM 40617–22, UF/FSM 21518–23, same data as holotype; MCZ 63125–31, Camp Perrin, 5 August 1960, A. S. Rand and J. D. Lazell, Jr.; ASFS X3361–62, Les Cayes, 2 August 1962, D. R. Paulson; MCZ 63111–17, Les Cayes, 3 August 1960, A. S. Rand and J. D. Lazell, Jr.; ASFS X3353–55, 9.9 km ENE Port-Salut, 650 feet (198 meters), 3 August 1962, D. C. Leber, D. R. Paulson; ANSP 27156–62, KU 93369–75, USNM 157926–27, Carrefour Canon, 500 feet (153 meters), 1 August 1962, R. F. Klinikowski, A. Schwartz; MCZ 63118–21, Carrefour Canon, 4–5 August 1960, A. S. Rand and J. D. Lazell, Jr.; MCZ 63122–24, Les Platons, above Carrefour Canon, 5 August 1960, A. S. Rand and J. D. Lazell, Jr.

Referred specimens: HAITI. *Dépt. du Sud*: Tombeau Cheval, 3 (MCZ 63132–34).

Definition: A subspecies of *A. distichus* characterized by moderate size (males to 54 mm, females to 45 mm snout-vent length), dorsum marbled with greens and browns of varying shades, dewlap with a rather restricted basal maroon (wine colored) blotch or spot and a broad pale yellow margin, modally 1/1 scales between the supraorbital semicircles and the interparietal and 0/0 supraorbitals in contact with interparietal, 2/2 scales in contact laterally with the postfrontals, and a low mean number (3.4) of median azygous head scales.

Distribution: The southern slopes of the Massif de la Hotte from Camp Perrin (and

[11] From Latin, *vinosus*, full of wine.

Tombeau Cheval?) and Les Platons, south to Les Cayes, and west onto the Presqu'île du Port-Salut; intergrades with *A. d. aurifer* at Cavaillon (Fig. 3).

Comments: The holotype of *A. d. vinosus* has the following measurements and counts: snout-vent length 53 mm, tail 35 mm, broken; 5 scales across snout, 5 loreal rows, semicircles in contact, 1/1 scales between supraorbital semicircles and interparietal, 0/0 supraorbitals in contact with interparietal, 2/2 scales in lateral contact with postfrontals, 20 fourth toe lamellae, 4 median head scales, "preoccipital" present, 6 postmentals.

The series of 102 *A. d. vinosus* has the following counts: snout scales 4 to 8 (mode 4), loreal rows 4 to 6 (mode 5); supraocular semicircles in contact in all specimens; modally 1/1 scales between supraorbital semicircles and interparietal and 0/0 supraorbitals in contact with interparietal; 2/2 scales in lateral contact with postfrontals; fourth toe lamellae 16 to 24 (mode 20); median azygous head scales 2 to 8 (mode 3, mean 3.4); "preoccipital" always present; postmentals 4 to 11 (mode 7, mean 7.4).

Compared with all other subspecies of *A. distichus*, from both the Hispaniolan mainland and the Bahamas, none is so easily differentiable as *vinosus*. The combination of maroon or wine-red centered dewlap with a broad yellow margin (Pl. II) and heavily mottled brown and green dorsum will distinguish it from any other subspecies. Only *A. d. juliae* on Ile-à-Vache resembles *A. d. vinosus* in dewlap color and pattern; *juliae* will be discussed further below. The amount of maroon in the basal spot of the *vinosus* dewlap is variable, and the illustrated individual (which is the holotype) resembles the maximal condition. The range of *vinosus* is bordered on the east by the orange-dewlapped *aurifer* and on the northwest by a yellow-dewlapped subspecies. In both cases, the contrast between the *vinosus* dewlap and that of its neighbors is striking, and the races are easily separable. In dorsal coloration, *vinosus* is most like *aurifer*, with a marbled or mottled pattern of browns and greens. As far as scales are concerned, there is nothing distinctive about *vinosus*; along with the Hispaniolan subspecies *dominicensis, sejunctus, favillarum*, and *aurifer*, *vinosus* has 1/1 scales between the supraorbitals and the interparietals and 0/0 supraorbitals touching the interparietal. With a mean of 3.4 median head scales, *vinosus* ranks low among all subspecies, and with a mean of 7.4 postmentals, it ranks among the highest.

A. d. vinosus is extremely common throughout its range and especially so at Camp Perrin, where it was observed and taken on trees and hedgerows along dirt roads. At Carrefour Canon, these lizards were abundant in a *cafetal* with cacao, shaded by a high canopy. In Les Cayes, *A. d. vinosus* was abundant about walls and buildings, trees and gardens, etc.

Intergrades between *vinosus* and the race to the northwest will be discussed later. Intergrades between *vinosus* and *aurifer* are represented by a series of three specimens from Cavaillon (ASFS X3729–31). The two males in this short series had dewlaps which had the basal maroon spot paler (more reddish-orange) than in *vinosus*, and the broad margin of the dewlap distinctly more orange—a combination which I interpret as demonstrating intergradation between the two subspecies. These Cavaillon specimens were collected on the same day as the topotypical series of *aurifer*, and direct comparisons of the intensities of the dewlap colors in both lots were made directly with one another.

I have associated the three specimens from Tombeau Cheval (MCZ 63132–34) with *vinosus* rather than *aurifer* or the race to the northwest on the basis of provenance. Tombeau Cheval lies on about the high point of the road between Les Cayes and Jérémie, and just north of Camp Perrin. Since Tombeau Cheval is closer to Camp Perrin than to any other locality whence

A. distichus is known in this region, I have considered the specimens from that locality as *vinosus*, although I admit the possibility of error in such an assignment in this particular region.

Anolis distichus juliae Cochran

Anolis dominicensis juliae Cochran, 1934, Occ. Papers Boston Soc. Nat. Hist., 8:169.

Type locality: Ile-à-Vache, Haiti.

Definition: A subspecies of *A. distichus* characterized by moderate size (males to 53 mm, females to 44 mm snout-vent length), dorsum brownish-gray to green, somewhat marbled with darker browns and greens, dewlap almost completely dark wine-red with a pale yellow margin, modally 0/0 scales between the supraorbital semicircles and the interparietal and 0/0 supraorbitals in contact with the interparietal, 2/2 scales in contact laterally with the postfrontals, and a low mean number (3.4) of median azygous head scales.

Distribution: Ile-à-Vache, Haiti(Fig. 3).

Comments: *A. d. juliae* is obviously an insular derivative of the mainland *A. d. vinosus*, which it resembles in general dewlap pigmentation. Four characters separate the two subspecies: 1) the wine-red pigment in the dewlap of *juliae* is brighter (more red) than that of *vinosus*, 2) the extent of the wine-red spot is greater in *juliae* than in *vinosus* (Pl. II), 3) the dorsum of *juliae* is generally paler and less marbled and dark than that of *vinosus*, and 4) the modal condition of 0/0 scales between the semicircles and the interparietal and 0/0 supraorbitals in contact with the interparietal differ from the 1/1 and 0/0 (respectively) modes in *vinosus*. Comparisons with the remaining races are unnecessary, since no subspecies, other than *vinosus*, has the red-blotched dewlap of *juliae*.

Measurements and scale counts of the holotype (a male) of *A. d. juliae* are: snout-vent length 47 mm, tail ca. 49 mm, broken; 4 scales across snout, 5 loreal rows, semicircles in contact, 1/0 scales between supraorbital semicircles and interparietal, 0/1 supraorbitals in contact with interparietal, 3/2 scales in lateral contact with postfrontals, 21 fourth toe lamellae, 4 median azygous head scales, "preoccipital" present, 8 postmentals.

Scale counts on the series of 31 *A. d. juliae* are: snout scales 4 to 8 (mode 4), loreal rows 4 to 6 (mode 5); supraorbital semicircles always in contact; modally 0/0 scales between the semicircles and the interparietal and 0/0 supraorbitals in contact with the interparietal; fourth toe lamellae 16 to 22 (mode 20); median azygous head scales 2 to 6 (mode 4, mean 3.4); "preoccipital" usually present (29 of 30 lizards); postmentals 5 to 9 (mode 8, but 6 has almost as high a frequency, mean 7.2).

Where we collected on the western end of Ile-à-Vache, *A. d. juliae* was moderately common, occurring about houses and on trees in cultivated areas, as well as on *Cocos* trunks in old coconut plantings.

Specimens examined: HAITI. *Ile-à-Vache*: no other locality, 9 (MCZ 37517—holotype, MCZ 37518–19—paratypes, MCZ 6171, MCZ 86767–71); western end, 22 (ASFS X3516–36, ASFS X3548).

Anolis distichus suppar[12] subsp. n.

Holotype: MCZ 81137, an adult male, from Dame-Marie, south side of town along coast, Dépt. du Sud, Haiti, taken 13 March 1966 by Richard Thomas. Original number V9236.

Paratypes (all from Dépt. du Sud, Haiti): ASFS V9237, same data as holotype; ASFS V9268, ca. 5 km (airline) S Dame-Marie, 13 March 1966, R. Thomas; ASFS V9269, ca. 10 km (airline) WSW Moron, 13 March 1966, R. Thomas; ASFS V9192–94, ASFS V9213, ca. 7.5 km (airline) WSW Moron, 13 March 1966, E. Cyphale, R. Thomas; MCZ 74766, MCZ 74768–810, MCZ 74812–25, Marfranc, 26–27 December 1962, D. Hill and F. Vuillemier; USNM 160682–86,

[12] From Latin, *suppar*, almost equal.

Jérémie, 9–10 March 1966, R. Thomas, native collectors; UF/FSM 21524–25, Jérémie, 11 March 1966, R. Thomas; AMNH 96501–04, Jérémie, 11 March 1966, R. Thomas, native collector; MCZ 63106, Jérémie, 31 July 1960, A. S. Rand and J. D. Lazell, Jr.; MCZ 3346, MCZ 86772–77, Jérémie, no date, D. F. Weinland; KU 93376–79, 2 km NW Jérémie, 14 March 1966, native collector; MCZ 69766–79, Carrefour Sanon, nr. Jérémie, December 1962, G. Whiteman; MCZ 69780–91, Place Nègre, nr. Jérémie, December 1962, G. Whiteman; CM 37811 + 10 untagged specimens, Place Nègre, nr. Jérémie, 10–11 December 1961, L. Whiteman; MCZ 69792–809, Mayette, nr. Jérémie, December 1962, G. Whiteman; MCZ 64630–37, Tiga, nr. Jérémie, 15 December 1960, G. and L. Whiteman; MCZ 69751, Lancenise, nr. Jérémie (not mapped), December 1962, G. Whiteman; MCZ 69757–65, La Source, nr. Jérémie (not mapped), December 1962, G. Whiteman; MCZ 69754–55, Perine, nr. Jérémie (not mapped), December 1962, G. Whiteman; MCZ 65627–28, nr. Jérémie, 1960, L. and G. Whiteman; MCZ 69752–53, Bozo, nr. Jérémie (not mapped), December 1962, G. Whiteman; ASFS V9359–60, ca. 8 km (airline) S Marché Leon, 3000 feet (915 meters), 15 March 1966, native collector.

Referred specimens: HAITI. *Dépt du Sud*: Tiburon, 6 (MCZ 6170, MCZ 86778–82); Paroty, nr. Jérémie (not mapped), 1 (MCZ 64638); Place Nègre, nr. Jérémie, 39 (MCZ 64675–713); nr. Jérémie, 7 (MCZ 3346).

Definition: A subspecies of *A. distichus* characterized by moderate size (males to 54 mm, females to 44 mm snout-vent length), dorsum pale green, somewhat marbled with gray and yellow, dewlap pale yellow to yellow-green or grayish yellow and at times with a dull yellow-orange basal smudge, modally 1/1 scales between the supraorbital semicircles and the interparietal and 0/0 supraorbitals in contact with the interparietal, 2/2 scales in contact laterally with the postfrontals, and a low mean number (3.4) of median azygous head scales.

Distribution: The extreme western tip of the Tiburon Peninsula in Haiti, from Dame-Marie east to Jérémie, and south on the northern slopes of the Massif de la Hotte in the vicinity of Marché Leon; occurrence at Tiburon problematical (see below) (Fig. 3).

Comments: The terminal subspecies on the western tip of the Tiburon Peninsula is remarkably different from its neighbors to the east (*aurifer*) and south (*vinosus*) and in fact resembles its relative *dominicensis* far to the east, both in dorsal color and dewlap color. In having a yellow dewlap (Pl. II), *suppar* is readily distinguishable from *aurifer* (orange dewlap) and *vinosus* (maroon-centered dewlap). The resemblances to *dominicensis* are strong, including a dorsal green color, a pale yellow dewlap, comparable means of median head scales (3.4 and 3.9), and 1/1 scales between semicircles and interparietal and 0/0 supraorbitals in contact with interparietal. The major differences are the higher mean number of postmentals (7.9 in *suppar*—the highest mean of any subspecies—and 6.6 in *dominicensis*) and the more pastel or paler green dorsum.

The measurements and counts for the holotype of *A. d. suppar* are: snout-vent length 52 mm, tail 65 mm; 5 scales across snout, 5 loreal rows, semicircles in contact, 1/1 scales between supraorbital semicircles and interparietal, 0/0 supraorbitals in contact with interparietal, 2/2 scales in lateral contact with postfrontals, 22 fourth toe lamellae, 4 median head scales, "preoccipital" present, 7 postmentals.

Scale counts for the series of 176 *A. d. suppar* are: snout scales 4 to 8 (mode 4), loreal rows 3 to 6 (mode 5); modally 1/1 scales between supraorbital semicircles and interparietal and 0/0 supraorbitals in contact with interparietal; 2/2 scales in lateral contact with postfrontals; fourth toe lamellae 16 to 25 (mode 18 and 19); median azygous head scales 1 to 7 (mode 3, mean

3.4); "preoccipital" usually present (170 of 176 lizards); postmentals 4 to 13 (mode 7, mean 7.9).

The dewlaps of *A. d. suppar* have been noted in life as pale yellow-green (Jérémie, Dame-Marie, and west-southwest of Moron) and pale yellow (Marché Leon; pl. 17 E 1, west-southwest of Moron). A male from the Moron region also has a dull yellow-orange (pl. 9 J 10) basal smudge. The dorsum is usually pale or pastel green, somewhat overlaid with grayish marbling and/or streaking, and commonly there are yellow or paler green middorsal blotches, especially on the anterior trunk and neck. Preserved specimens, regardless of freshness of preservation, very regularly show both a broad dark (black) V-shaped collar which arises from about the angle of the jaws and extends across the neck, and a large dark (black) area on the upper side of the head, separated from the collar by a narrow paler (gray) V-shaped band. Since no note of these markings was made in life, they must not be conspicuous in the living animal, but they are remarkably consistent in the preserved lizards. I do not know if *suppar* is capable of a brown phase.

Comparisons of *suppar* with the adjacent *aurifer* and *vinosus* were made above. From the orange-dewlapped subspecies *biminiensis, distichoides, dapsilis, ignigularis, tostus,* and *favillarum, suppar* differs in having a yellow dewlap. From *juliae, suppar* also differs in having a yellow dewlap instead of a dewlap with an extensive wine-colored basal blotch. From the yellow-dewlapped races (*distichus, ocior, properus, sejunctus,* and *ravitergum*; comparison with *dominicensis* was made above) *suppar* differs in being (always?) green (in contrast to *distichus, properus, sejunctus,* and *ravitergum*) and in lacking the lateral pale line of *ocior* (although many *suppar* have the flank stripe fairly well developed, it is not clearly outlined above and below by darker). Other differences from *ocior* include a much lower mean number of median head scales (3.4 versus 5.8), 1/1 scales between the semicircles and the interparietal (0/0 in *ocior*), and 0/0 supraorbitals in contact with the interparietal (1/1 in *ocior*).

The specimens from Tiburon were collected by Garman and thus are quite old and faded, and there are no color data on them. I consider them *suppar* only provisionally; Tiburon is 28 kilometers airline south of Dame-Marie, but it may be precisely in this intervening region that *suppar* intergrades with *vinosus*. The Tiburon lizards may be *vinosus*; there are no specimens from any locality between Dame-Marie and Tiburon, on the one hand, or between Tiburon and Port-Salut, on the other.

Although there is no evidence of intergradation between *suppar* and *vinosus*, there is evidence of intergradation between *suppar* and *aurifer*. A series (MCZ 74826–32) from Roseaux was noted as having the dewlap with a "deep orange rust spot at base." It may be recalled that there is a sight record of an *aurifer* from 7.5 km (airline) south-southeast of Roseaux. The zone of intergradation between *suppar* and *aurifer* appears to be very narrow, centering in the region about Roseaux.

A. d. suppar is quite common throughout most of its range, occurring from sea level to elevations of 3000 feet (915 meters) above Marché Leon on the northern slopes of the Massif de la Hotte. In habitat, it does not differ from other altitudinally wide-ranging races, in that it was taken in edificarian situations, along the southern slopes of the Monts Cartaches, and in both natural and artificial wooded situations which the species inhabits throughout its range.

Anolis distichus patruelis[13] subsp. n.

Holotype: MCZ 81138, an adult male, from vicinity of Pointe Sable, Ile Grande

[13] From Latin, *patruelis*, relating to a cousin.

Cayemite, one of a series taken 18 March 1966 by Richard Thomas and native collectors. Original number V9409.

Paratypes: ASFS V9410–14, ASFS V9423–26, MCZ 81142–46, USNM 160687–91, AMNH 96505–08, same data as holotype; MCZ 25519, Grande Cayemite, 3 August 1927, W. J. Eyerdam.

Definition: A subspecies of *A. distichus* characterized by small size (males to 50 mm, females to 42 mm snout-vent length), dorsum green to gray, usually not prominently striate, dewlap solid dark reddish to mustard orange, modally 1/1 scales between the supraorbital semicircles and the interparietals and 0/0 supraorbitals in contact with the interparietal, 2/2 scales in contact laterally with the postfrontals, and a moderate mean number (4.6) of median azygous head scales.

Distribution: Ile Grande Cayemite, Haiti (Fig. 3).

Comments: The measurements and scale counts for the holotype of *A. d. patruelis* are: snout-vent length 49 mm, tail ca. 60 mm; 4 scales across snout, 4 loreal rows, semicircles in contact, 1/1 scales between supraorbital semicircles and interparietal, 0/0 supraorbitals in contact with interparietal, 2/2 scales in lateral contact with postfrontals, 19 fourth toe lamellae, 2 median head scales, "preoccipital" present, 8 postmentals.

The series of 25 *A. d. patruelis* has the following counts: snout scales 4 to 8 (mode 4), loreal rows 4 to 6 (mode 4); modally 1/1 scales between supraorbital semicircles and interparietal and 0/0 supraorbitals in contact with interparietal; 2/2 scales in lateral contact with postfrontals; fourth toe lamellae 16 to 22 (mode 20); median azygous head scales 2 to 7 (mode 4, mean 4.6); "preoccipital" always present; postmentals 6 to 11 (mode 8, mean 7.8).

The dorsum of *A. d. patruelis* varies between green and gray; most specimens show little or no striae, but others have a lineate dorsum. The dewlap varies in life from dark reddish to mustard orange (pl. 6 K 9, pl. 5 L 11), and has an orange (rather than pale yellow) margin (Pl. II).

Ile Grande Cayemite is adjacent to the northern section of the presumed mainland range of *A. d. aurifer*, and *A. d. patruelis* resembles the former subspecies in dewlap color. A major difference is the absence in *patruelis* of the narrow yellow dewlap margin which occurs in *aurifer*; the richer and deeper hues of the *patruelis* dewlap are likewise different than the brighter pigments of *aurifer*. The back of *aurifer* is heavily marbled and mottled with greens and browns, whereas that of *patruelis* is generally much plainer, lacking pronounced mottling, and is rarely clearly striate.

A. d. patruelis, with its deep orange dewlap, differs from the subspecies which have yellow dewlaps (*distichus, ocior, dominicensis, properus, sejunctus, ravitergum*, and *suppar*) and those which have a maroon or wine-red basal spot (*vinosus, juliae*). The other orange-dewlapped subspecies are *biminiensis, distichoides, dapsilis, ignigularis, tostus, favillarum* (and *aurifer*, with which *patruelis* was compared above). Aside from the differences in dorsal pigmentation and pattern, the deeper hue of the dewlap color, and the absence of a yellow dewlap margin in *patruelis*, the Grande Cayemite subspecies differs from all other orange-dewlapped forms in having a very high mean of postmentals (7.8 in *patruelis*, 3.7 to 7.2 in other orange-throated subspecies, with *aurifer* having the highest mean). In fact, other than *suppar*, *patruelis* has a higher postmental mean than all other subspecies.

Most of the paratypic series were native collected; the lizards came from dry scrubby woods growing on almost bare limestone and from about the village at Pointe Sable.

There is a short series (USNM 80814–18) of *A. distichus* from Ile Petite Cayemite, just to the west of Grande Cayemite. These specimens have long been in preservative, and consequently no details of coloration or pattern are discernible. They may be

patruelis, although, as pointed out for *Ameiva taeniura* Cope, which is known from both the Cayemites, there is a possibility that each island has its own subspecies (Schwartz, 1967a). In this short Petite Cayemite series of five specimens, the postmentals range between 4 and 7 (two specimens have counts of 4 and 5, and are thus lower than the much longer series from Grande Cayemite). One lizard (USNM 80818) has only a single median azygous head scale, the "preoccipital," a condition not observed in the Grande Cayemite series. I consider the Petite Cayemite lizards *A. d. patruelis* only provisionally.

The Florida Populations

Anolis distichus was first reported from the continental United States by Smith and McCauley (1948), who described *A. d. floridanus* on the basis of a short series of six specimens from Brickell Park in downtown Miami, Florida. The status of the mainland lizards was later discussed by Duellman and Schwartz (1958:279–281), who regarded *floridanus* as a synonym of *A. d. distichus*. Of the four scale characters and one pigmental trait, these authors noted that "*floridanus*" (of which form they examined 77 specimens in detail) agreed with topotypical *distichus* in number of infraorbital scales, number of scales bordering the median suture (= median azygous head scales), and in having the throat unpigmented, but disagreed with the nominate subspecies in having a higher percentage (63.6 per cent versus 14.0 per cent) of specimens with the supraocular semicircles separated and in the modal number of scales separating the prefrontal from the anterior supraocular (mode 1 and 2 with almost equal frequencies in "*floridanus*," mode 2 in topotypical *distichus*). With increased knowledge of *Anolis distichus* in its insular range, it is appropriate to reassess the status not only of "*floridanus*" but also that of another mainland Floridian population.

Through the efforts of C. Rhea Warren, I have been able to examine a short series of seven lizards (RT 1478–84) from Northwest South River Drive in Miami, Florida. These lizards were green in life and capable of becoming solid brown; they represent a small sample from a large and very successful colony centering near the junction of the Miami Canal (the northwestern extension of the Miami River) and the artificial Tamiami Canal. The specimens are typical in all ways of *A. d. dominicensis*, with the possible exception of three of the seven specimens having 3/3 scales in lateral contact with the postfrontals. This high frequency is doubtless due to the small sample size; in the series of 245 *A. d. dominicensis* from Hispaniola, 32 have 3/3 scales in lateral contact with the postfrontals, whereas 162 have 2/2 scales in this position. The yellow dewlaps with occasional orange basal blush and the green dorsa agree in detail with my concepts of *A. d. dominicensis*, and I assume that these lizards have been recently introduced into this region through some fluke of international shipping. King and Krakauer (1966:146) have reported this population as *A. d. dominicensis* at my suggestion.

Anolis distichus floridanus Smith and McCauley

Anolis distichus floridanus Smith and McCauley, 1948, Proc. Biol. Soc. Washington, 61:160.

Type locality: Brickell Park, Miami, Dade County, Florida.

Definition: A subspecies of *A. distichus* characterized by small size (males to 50 mm, females to 45 mm snout-vent length), dorsum gray to dark brown and without a green phase, dewlap pale yellow (occasionally pale orange), modally 1/1 scales between the supraorbital semicircles and interparietal, 0/0 supraorbitals in contact with the interparietal, 2/3 scales in contact laterally with the postfrontal, and very high mean number (7.9) of median azygous head scales correlated with the very high incidence (about 60 per cent) of complete

separation of supraocular semicircles medially.

Distribution: Known only from the extreme eastern coastal and near-coastal margin of Dade County, Florida (Fig. 2).

Comments: I have examined 90 *A. distichus* (aside from the *A. d. dominicensis* noted above) from southern Florida. Although Duellman and Schwartz (1958: 279–281) considered *A. d. floridanus* synonymous with *A. d. distichus* from New Providence, the above definition clearly shows that *floridanus* differs from *distichus* in several characters which elsewhere in the Bahamas and Hispaniola I regard as indicative of subspecifity. The use of the name *A. d. floridanus* for the continental lizards mainly involves the philosophical problem of its appropriateness if the mainland *A. distichus* have been introduced only recently by man. This question is discussed below.

The two major samples which I have studied come from two localities (Brickell Park and its vicinity in downtown Miami, and Fairchild Tropical Garden). Mr. Warren advises me that *A. distichus* occurs elsewhere in Miami and in Coral Gables, Florida, and Wayne King (*in litt.*, 28 September 1966) reported its occurrence at one additional locality in Miami, four in Coral Gables, three in Coconut Grove, and one in Kendall. I have not examined material from any of these localities. Dr. King suggests that the Brickell Park-Fairchild Garden population is continuous (the Coconut Grove localities and a locality at the junction of Brickell Avenue and the Rickenbacker Causeway in downtown Miami fill in fairly well the hiatus between the two presumed terminal stations for *A. d. floridanus*), and I concur. King and Krakauer (1966:146) stated that all other localities are the result of secondary introductions by reptile fanciers; a second method for dispersal may be that Fairchild Garden supplies plants for ornamental purposes to Dade County and to private persons for decorative planting, with resultant accidental distribution of *A. floridanus* throughout the county.

The two terminal localities are distant about 8.5 miles (13.6 km) from one another. Both are more or less coastal, and Fairchild Tropical Garden has for many years been a center to which plants from outside the United States have been introduced for purposes of culture and exhibit. The Brickell Park locality lies in downtown Miami on the coast on the south side of the Miami River. The lizards are extremely abundant at both localities. In most characters the two samples are alike, and if they represent two different "introductions," their later convergence has been along remarkably similar lines.

The largest mainland male and female are both from Brickell Park (snout-vent length 50 mm in the male, 45 mm in the female), whereas the largest of each sex from Fairchild Garden are 47 mm and 39 mm. The scale characters of the two populations are: snout scales 3 to 6 (mode 6) at Brickell Park, 3 to 7 (mode 6) at Fairchild Garden; loreal rows 4 and 5 (mode 4) at Brickell Park, 4 to 6 (mode 4) at Fairchild Garden; semicircles usually not in contact (27 of 42 lizards from Brickell Park, 25 of 48 lizards from Fairchild Garden); modally 1/1 scales between the supraorbital semicircles and the interparietal and 0/0 supraorbitals in contact with the interparietal in both samples; fourth toe lamellae 15 to 19 (both localities), modes 17 or 18 (Brickell Park) and 18 or 19 (Fairchild Garden); modally 3/3 scales in lateral contact with postfrontals at Brickell Park, but almost an equal frequency of 2/2 at this locality; modally 2/3 scales in lateral contact with postfrontals at Fairchild Garden; median azygous head scales 5 to 12 (mode 8, mean 8.0) at Brickell Park, 4 to 10 (mode 8, mean 7.8) at Fairchild Garden; "preoccipital" usually present (40 of 42 lizards from Brickell Park, 42 of 48 lizards from Fairchild Garden); postmentals 3 to 6 (mode 4, mean 4.3) at Brickell Park, 3 to 8 (mode 5 or 6, mean

4.4) at Fairchild Garden. The dewlap is pale yellow to yellow with an extensive pale orange blush; dorsally the lizards are gray, incapable of a green phase but capable of becoming dark brown.

The mainland *A. distichus* obviously are related to the Bahaman populations of the species rather than to the Hispaniolan forms. Such features as the high incidence of complete separation of the semicircles, the low number of postmentals, and the lack of a green phase all point to the Bahamas as the place of origin of *A. d. floridanus*. It has generally been assumed that the continental *A. distichus* are the result of a very recent introduction, either fortuitous or intentional, by man from the Bahamas. If such were the case, it should be a simple matter to determine from which of the five Bahaman subspecies *floridanus* has been drawn. This is not the case; *A. d. floridanus* presents a suite of characters which distinguishes it from all Bahaman, as well as Hispaniolan, populations. If the forerunners of *floridanus* were only recently introduced by man, then differentiation in Florida of *floridanus* must have been extremely rapid. If, on the other hand, *A. d. floridanus* has had a history other than that generally accepted—i.e., it has been in Florida for a longer period or *A. d. floridanus* has been introduced only recently but evolved its peculiar characteristics elsewhere—its differences from any other subspecies could be accounted for more readily. Evidence for the relationship and a suggested history of the continental populations are offered below.

Turning first to dorsal and dewlap colors, *floridanus* resembles all the Bahaman subspecies except *ocior* in the former (since *floridanus* lacks a green phase) and only *distichus* in the latter. The scale characters, on the other hand, are distinctive. The very high incidence of complete separation of the semicircles (57.8 per cent if both samples are combined; 64.2 per cent in the Brickell Park sample alone, 52.1 per cent in the Fairchild Garden sample alone) is much greater than that of any Bahaman subspecies, being approached most closely by *distichoides* (32.1 per cent) and *biminiensis* (30.2 per cent). In modally having 1/1 scales between the semicircles and the interparietal, *floridanus* differs from all Bahaman populations except *distichoides*. New Providence and Exuma Cays *A. d. distichus* do have 1/1 as the modal condition (or as a bimode in the former case), however. Although the modal condition is 2/3 scales in lateral contact with the postfrontals in *floridanus* (30 individuals), 29 lizards have 2/2 scales in lateral contact and 25 have 3/3 (of which 15 are from Brickell Park, where 3/3 is the mode). Such a high incidence of 3/3 scales in lateral contact with the postfrontals is unequalled in any Bahaman population except *biminiensis*, where 3/3 is the mode.

The mean of 7.9 median azygous head scales in *floridanus* is higher than that of any Bahaman subspecies with the exception of 8.7 in *distichoides*. In having 0/0 supraorbitals in contact with the interparietal, *floridanus* is like *distichus*, *distichoides*, and *dapsilis*, but unlike *biminiensis* and *ocior*. The regular occurrence of the "preoccipital" in *floridanus* resembles the condition in all Bahaman subspecies except *distichoides* and *biminiensis* which more often lack the "preoccipital." Finally, the mean of 4.4 postmentals in *floridanus* is lower than those of all Bahaman populations, being most closely approached by *distichoides* (4.6) and *biminiensis* (4.8).

From the above resume, it is apparent that, although *floridanus* agrees with nominate *distichus* in dorsal and dewlap colors, it differs markedly from it in scale characters. The two populations which bear the closest resemblance in scalation to *floridanus* are *distichoides* and *biminiensis*, and, not unexpectedly, these two races are those most geographically adjacent to *floridanus*. The occasional occurrence in *floridanus* of a pale orange dewlap also suggests that one or the other of these

orange-dewlapped subspecies may have been the source of *floridanus*.

There are three possible histories for the continental population of *A. distichus*:

1) The populations were indeed accidentally or purposely introduced by man in the relatively recent past (shortly prior to their discovery and description in 1948) from somewhere in the Bahamas.

2) The populations are the result of a natural overseas introduction from somewhere in the Bahamas whose population as yet remains unsampled; the Bimini chain or Andros seem likely candidates, but *A. d. floridanus* does not agree with either *biminiensis* or *distichoides* in all details of color or scalation.

3) The populations reached Florida during the Pleistocene from the Bahamas but remained undetected there until 1948, by which time their precise place of origin in the Bahamas had become obscure because of *in situ* evolution to *A. d. floridanus* on the mainland.

Several facts should be taken into consideration before proceeding. 1) *A. d. floridanus* is closest in characteristics to those Bahaman lizards which are geographically most nearly adjacent to the mainland—*biminiensis* and *distichoides*. 2) The distribution of *A. d. floridanus* is primarily coastal (as one might expect of a natural invader) and is not now (and perhaps was not ever) disjunct, as previously supposed. 3) Although there is much overseas boat traffic between the Biminis and Miami, there is less between Andros and Florida; Dr. King has pointed out that "in the early nineteen hundreds there were large four-, five- and six-masted barks that sailed freight all over the Bahamas and between the Bahamas and Florida. Any of these could have been a vehicle for introducing *distichus* into Florida." 4) That *A. distichus* arrived in Florida in the Pleistocene but remained undetected until the present century may take credulity. It is not impossible that such a chain of events took place, since the Miami region has only in the present century been a large urban center, and small or restricted coastal populations of this fast-moving and inconspicuous lizard could have been easily overlooked by earlier collectors and visiting scientists, who likely were more concerned with protecting themselves from mosquitoes in the coastal regions where *A. d. floridanus* occurs. 5) Along these lines it is interesting to note that *A. d. distichus* was first described from New Providence in 1861, whereas Nassau was the home of the First Royal Governor of the Bahamas in 1718, and through the following century and a half became a veritable Bahaman metropolis, far more visited by travelers and scientists than the Miami region. No one suggests that *A. d. distichus* owes its tenancy of New Providence to the years just prior to the year it was described, yet this has always been the assumption of the status of *A. d. floridanus*.

Considering all of the above facts and suggestions, I adhere to a combined sequence of events as regards *A. d. floridanus* as noted above in postulations (1) and (2). I think it most likely that *A. d. floridanus* was introduced, either by natural overseas transport or by man long before its discovery in 1948 but in historical times. The source of this introduction remains a mystery, but one region may be mentioned. The west coast of Andros is very poorly known zoologically, and this coast is the one closest to the Florida mainland. The fragmentation of Andros by cross-island waterways and bights and its large size (Andros is as large as Puerto Rico but less physiographically diverse) suggest that intra-island differentiation in some reptiles may have taken place there. This is indeed the case with Andros *Ameiva auberi* (personal communication, Clarence J. McCoy, Jr.), and there is no reason to doubt that it occurred in other reptiles. Verification of this supposition can be had only by collection of series of specimens from this inaccessible west coast. Dr. King is the only scientist who has crossed the Big Mud to western Andros in recent times, and he secured but

a single female *A. distichus* there. Western Andros remains the only extensive area in the Bahamas whose fauna is extremely poorly known.

The geographical juxtaposition of this coast to Florida makes it even more attractive as a source of introduction of *A. d. floridanus*. The assumed derivation of *A. d. floridanus* from *A. d. distichoides* is logical, considering the resemblances between the two in some scale features. Dr. King (*in litt.*, 30 September 1966) suggested that the Bahaman sponge fleet used to ply the waters of the large banks in the Bahamas (including the Big Mud west of Andros). Boats from the fleet put into Miami for sale of cargo until the Bahaman sponge industry was destroyed by the sponge blight in 1938 and 1939. Intentional or accidental transportation of *A. d. floridanus* from the west coast of Andros to the Miami area might well have been effected by ships in the sponge trade. If such is the case, then, *A. d. floridanus*, despite its name, is in reality a Bahaman subspecies from the western section of Andros which has been introduced into Florida in the relatively recent past.

Specimens examined: FLORIDA. *Dade County*: Brickell Park, 35 (UMMZ 106189–31 specimens, UMMZ 108100, UMMZ 108372–3 specimens); south of Miami River on Brickell Ave., Miami, 7 (UMMZ 109232); Fairchild Tropical Garden, Miami, 48 (RT 1485–97, UMMZ 108189–2 specimens, UMMZ 108190–6 specimens, UMMZ 108371–25 specimens, UMMZ 109231–2 specimens).

DISCUSSION

Anolis distichus is one of the most widely distributed species of amphibian or reptile in the Antillean region; its occurrence on Hispaniola, the Bahamas, and Florida is exceeded by that of another anole (*Anolis sagrei* Duméril and Bibron on the Bahama Islands north of the Crooked Island Passage, Cuba and the Isla de Pinos, Jamaica, Cayman Islands, Península de Yucatán, Swan Islands, Florida Keys), of *Typhlops lumbricalis* Linnaeus (Bahama Islands north of the Crooked Island Passage, Cuba and the Isla de Pinos, Hispaniola), and of the boa *Epicrates angulifer* (Great Bahama Bank, Sheep Cay off Great Inagua, Cuba and the Isla de Pinos, Hispaniola). Throughout its range, *A. distichus* varies in success; in more mesic situations and on some islands, it may be very abundant, but in xeric regions it is less so or absent.

As far as the Bahaman herpetofauna is concerned, *A. distichus* holds a unique position. It is generally conceded that the Bahaman herpetofauna has been derived mainly from that of Cuba, with a smaller Hispaniolan element. There are 13 Cuban forms in the Bahamas (*Hyla septentrionalis, Eleutherodactylus planirostris, Sphaerodactylus decoratus, Sphaerodactylus notatus, Tarentola americana, Anolis angusticeps, Anolis carolinensis, Anolis sagrei, Leiocephalus carinatus, Leiocephalus loxogrammus, Ameiva auberi, Typhlops biminiensis* and *Typhlops lumbricalis*). These species all have Bahaman and Cuban populations which are identical or only racially differentiated, with the exception of *L. loxogrammus* (which is endemic to the Bahamas but closely related to the Cuban *L. raviceps*) and *Typhlops lumbricalis* (in which the nominate form occurs both in the Bahamas and in part of eastern Cuba). The latter species likewise is presumed (Thomas, in press) to have originated on Hispaniola rather than Cuba, but it is included here as a Cuban element in the Bahaman fauna, since the Bahaman populations have been derived directly from Cuba rather than from Hispaniola. In general, the Cuban species are limited in the Bahamas to the islands north of the Crooked Island Passage (i.e., the Great and Little Bahama banks), although there are exceptions (*L. loxogrammus*), and some forms may not occur on both banks (*A. carolinensis*) or may occur only, but not be widespread, on the Great Bahama Bank (*T. americana*). However, compared to

the Hispaniolan faunal element in the Bahamas, the species with Cuban affinities are widely distributed.

The Bahaman species with Hispaniolan affinities include eight species (*Aristelliger cochranae, Sphaerodactylus inaguae, Anolis distichus, Leiocephalus inaguae, Leiocephalus arenarius, Ameiva maynardi, Epicrates exsul,* and *Epicrates angulifer*). I include *E. angulifer* in this series rather than with the Cuban element (the species occurs on both islands), since the more widely ranging Bahaman subspecies is more closely related to the Hispaniolan than the Cuban race. Of these eight species, five are limited to the islands between the Crooked Island Passage and Hispaniola, one (*E. exsul*) to the Little Bahama Bank, and the remaining two (*A. distichus* and *E. angulifer*) occur on the Great Bahama Bank (or at least primarily on this bank). *Sphaerodactylus "anthracinus"* on New Providence and Andros is without doubt introduced from Hispaniola, since the Bahaman form (*"anthracinus"*) is identical with one of the Hispaniolan subspecies of *S. copei.* Thus of the eight Bahaman species with Hispaniolan affinities, only two (*A. distichus* and *E. angulifer*) are widespread in the Bahamas, whereas 12 of the 13 Cuban species are widespread on the Great Bank. (There are 19 other species of reptiles—including seven nominal species of the genus *Cyclura*—in the Bahamas, but these are not readily classifiable as to origin; none is obviously or certainly related to either Hispaniolan or Cuban congeners, and need not concern us further in this context.)

From the above brief summary of the affinities of the Bahaman herpetofauna, it appears that *A. distichus* has a rather unique position therein, since it is one of the two Bahaman reptiles which are widespread in the Bahamas and have had an Hispaniolan origin. Noteworthy is the fact that *A. distichus* is absent from the Bahamas south of the Crooked Island Passage, and from the Turks and Caicos islands. This is peculiar, since these islands would seem to have been likely and handy stepping-stones from the Hispaniolan mainland to the Great Bahama Bank. Not only is *A. distichus* absent from these islands, but they have only a single anolis (*A. scriptus*), which is not closely related to *A. distichus* (*scriptus*, although associated with *distichus* as an Eastern Island Alpha anole, belongs to the *cristatellus* rather than the *bimaculatus* group; *fide* Etheridge, *in litt.*). There is no *distichus* relative in Cuba, the more logical place for invasion of the Great Bahama Bank. It seems then that *A. distichus* arrived on the Great Bahama Bank directly from Hispaniola, without using either Cuba or the southern Bahamas south of the Crooked Island Passage as way stations.

I have already commented on the general, although not absolute differences between the Bahaman and Hispaniolan segments of *A. distichus.* These differences are not especially striking, either in dewlap color and pattern or in dorsal color. The complete absence of separation of the semicircles in any Hispaniolan *A. distichus*, the higher mean numbers of median head scales in the Bahamas, and the tendency toward absence of the "preoccipital" in the Bahamas do indicate, however, that the Bahaman lizards have diverged as a unit in some scale characters. Most Bahaman subspecies have lost the ability to become green, and this phenomenon has taken place also in some Hispaniolan populations. In general, the loss of the green phase is correlated with more arid, in contrast to distinctly mesic, situations. However, the range of *A. d. ocior* in the Bahamas is not especially more mesic than that of the other Bahaman subspecies, and *ocior* retains a green phase. It is suggestive that those islands (Rum Cay and San Salvador) inhabited by *ocior* are two of the three Bahaman islands occupied by *A. distichus* which are not on the Great Bank. The other exception, Cat Island, is presently *(ensis)* in having a yellow dewlap and

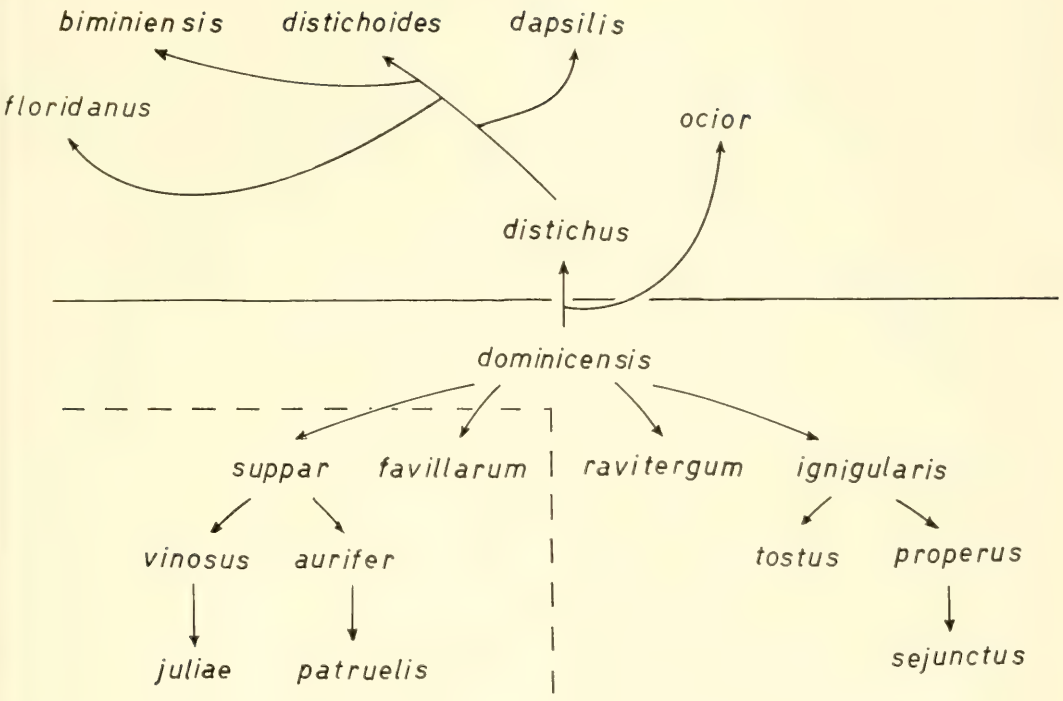


Figure 4. Dendrogram of the relationships between the subspecies of *Anolis distichus*. Bahaman subspecies above solid horizontal line, Hispaniolan subspecies below solid horizontal line; subspecies on the south island of Hispaniola and its satellite islands enclosed within dashed line in lower left of diagram.

cut off from the Great Bank, but in contrast to Rum and San Salvador, Cat is not far removed from the Great Bank and is still connected to Eleuthera by a narrow submarine strip (Clench, 1938:536). Its history has been at least partially associated with that of the Great Bank.

Not only does *A. d. distichus* have the broadest distribution of any subspecies in the Bahamas, but it also resembles the most widespread Hispaniolan race (*A. d. domini-* also is the Bahaman subspecies which occurs closest geographically to Hispaniola on the Ragged Islands and Long Island. *A. d. distichus* seems appropriate, both geographically and in dewlap color, as a direct Bahaman derivative from Hispaniola (Fig. 4). In the Bahamas, various subspecies have differentiated from *A. d. distichus* on more or less peripheral islands or island groups. Thus, *biminiensis, distichoides,* and *dapsilis* are all essentially orange-dewlapped *A. distichus* with head scutellation features differing from those of *A. d. distichus* but occurring in the latter subspecies as casual variants.

A. d. ocior, in contrast to the balance of the Bahaman races, retains a green phase and a yellow dewlap—characters which ally it directly with *dominicensis*. It does, however, have some "Bahaman" characteristics, such as the high number of median head scales. Possibly *ocior* reached Rum Cay and San Salvador from the Great Bahama Bank prior to the loss of the green phase by the parental stock there, but at a time when some head scale modifications were already established or becoming so. I do not consider it likely that *ocior* has had a direct and separate connection with *dominicensis*, but rather that it has had a long history independent of that of the balance of the Bahaman races.

On Hispaniola, the situation is more

complex. In essence there is a single, widespread, yellow-dewlapped subspecies (*dominicensis*) with a series of "peripheral" races on the mainland (*ignigularis, properus, ravitergum, favillarum, aurifer, vinosus, suppar*) and a series of subspecies from the satellite islands (*sejunctus, tostus, juliae, patruelis*). Of the mainland subspecies, those with plain or drab dorsa and yellow dewlaps in general inhabit the more arid regions (*properus, ravitergum*) and the orange-dewlapped and brightly colored subspecies inhabit both lowland and highland mesic areas (*ignigularis, favillarum, aurifer*). *A. d. suppar* is a distinct exception to this statement, since the extreme tip of the Tiburon Peninsula is mesic, and *suppar* is a green lizard with a yellow dewlap, much like *dominicensis*. The most strikingly different mainland subspecies in dewlap color is *vinosus*.

Of the satellite island races, all but one resemble their relatives on the immediately adjacent mainland in dewlap color and in color repertory. The major exception is *A. d. tostus* on Isla Catalina. The adjacent mainland is inhabited by *properus*, which is yellow-dewlapped, whereas *tostus* has essentially an orange dewlap, more like that of *ignigularis* to the west. The faunal history of Isla Catalina is peculiar, in that it includes an endemic and relict subspecies of *Ameiva lineolata* and a population of *A. chrysolaema*, a species which is not known from the adjacent coast. Both these lizards, as well as *tostus*, show distinctly more western than adjacent or eastern affinities. Under these circumstances it is likely that *tostus* represents an *ignigularis*, rather than a *properus*, derivative, and that through changing conditions on the adjacent mainland, there has been a shift to the westward of subspecies along the coast, with *properus* replacing *ignigularis*. As far as the balance of the satellite island races is concerned, none presents any problem. It is noteworthy that *juliae* shares with *vinosus* on the adjacent mainland the strikingly different style of dewlap pigmentation and pattern.

Although not now a satellite island, the Península de Samaná presumably was so at one time. The occurrence there of a disjunct population of *ignigularis* has been discussed in detail in the text.

There is no way of determining whether *A. distichus* was primarily and primitively an inhabitant of the historical north or south island (*sensu* Williams, 1961) of Hispaniola. The occurrence of *dominicensis* on most of the north island and on the basal half of the Tiburon Peninsula suggests in some ways that the species was primarily north island, and invaded the south island secondarily. This thesis presents the problem of the very distinct and apparently isolated *favillarum* in the Sierra de Baoruco, and the exceptionally distinctive *vinosus* and *juliae* on the distal Tiburon Peninsula and Ile-à-Vache. The three subspecies on the tip of the Tiburon Peninsula (*suppar, vinosus, aurifer*), of which two are quite different in dewlap color from *dominicensis*, may indicate that this region was colonized directly from the north island across the Golfe de la Gonâve and not serially along the peninsula itself. If so, then these terminal populations may have diverged independently and remained isolated from other *A. distichus* populations until the arrival of *dominicensis* across the much narrower inter-island strait and subsequent contact along the Tiburon Peninsula. *A. d. favillarum* in the Sierra de Baoruco may represent still another isolated derivative from a north island stock. I cannot suggest that *favillarum* was historically derived from the adjacent lowland and drab *ravitergum*, however. Another possibility is that *favillarum* is an upland offshoot from *dominicensis* (just as, to the east, *ignigularis* is an orange-dewlapped *dominicensis* derivative) in the Sierra de Baoruco, and thus has evolved rather recently. The apparent absence of *A. distichus* from the southern side of the Valle de Neiba in this

particular region seems to enforce the latter suggested derivation of *favillarum*.

Although *A. distichus* is very widespread in Hispaniola, its absence in two regions is remarkable. The species is unknown from Ile de la Gonâve, which is inhabited by the *A. distichus* cognate, *A. brevirostris*. Although the coast of Gonâve is hot and arid, the interior is less hostile and more shaded. It is strange that *A. distichus* and *A. brevirostris* do not share Gonâve as they do similar portions of the mainland.

The other major region whence *A. distichus* is absent is the Península de Barahona. The lowlands of this peninsula, south of the Sierra de Baoruco, are inhabited exclusively by *A. brevirostris*, again, as on Gonâve, despite the ample availability of apparently suitable habitat for *A. distichus*. The species likewise is unknown from the coastal lowlands on the Península from the city of Barahona south (*A. brevirostris* is the exclusive species of the pair in Barahona itself and its environs), and also apparently along the southern Haitian coast between the Dominican village of Pedernales east to the area near Jacmel. (There is some doubt in this latter case because of the confused and unlocatable records for *A. distichus* labeled as coming from localities "near Saltrou." At least, all locatable stations where *A. distichus* has been taken "near Saltrou" are upland, and this is nicely correlated with the occurrence of the species on the Dominican side of the border north of Pedernales in the extreme eastern Sierra de Baoruco.)

The Península de Barahona south of the Sierra de Baoruco is emerging in Hispaniolan herpetology as a most distinctive area. The high mountain massifs of the Baoruco to the north and the La Selle to the west, coupled with the narrow and steep coastal "plain" at the eastern end of the Sierra de Baoruco, effectively trap lowland xerophiles to the south. Included in the list of such disjunct or practically disjunct forms are *Typhlops syntherus* and *Leptotyphlops pyrites* as endemic species; *Ameiva chrysolaema ficta* and *A. c. leberi*, *Ameiva lineolata privigna*, *Leiocephalus barahonensis oxygaster* and *aureus*, *Diploglossus curtissi aporus*, *Amphisbaena gonavensis hyporissor* and *A. g. leberi* as endemic subspecies. Although *A. brevirostris* is by no means restricted to this region, it is of interest that *A. distichus* has been unable to penetrate it either along the steep eastern coastal "plain," or from the uplands of the eastern Massif de la Selle or from the Sierra de Baoruco. *A. brevirostris* is the conspicuous and common member of the pair in the lowlands south of the mountains.

Although the Península de Barahona is in general arid, there seem to be ample areas which would be quite suitable for *A. distichus*; such regions are invariably inhabited by *A. brevirostris*. Correlated with the absence of *A. distichus* from the Península de Barahona is its absence from Isla Beata (which has the endemic subspecies *A. brevirostris wetmorei*). The Beata fauna is easily derivable from that on the adjacent Península de Barahona, and the lack of *A. distichus* on Beata is not noteworthy. The relationships of *Anolis altavelensis* on Isla Alto Velo have already been noted.

Although I am reluctant to attribute the absence of a species from a particular region to the catch-all phenomenon of competition, an explanation which may be glibly invoked without precise data, the situation between *A. distichus* and *A. brevirostris* suggests very strongly that competition may indeed be the reason for the absence of the former in some regions occupied by the latter. The Ile de la Gonâve and the Península de Barahona are both arid regions. In the Cul de Sac Plain, where mesic oases occur within otherwise arid scrub, *A. distichus* is confined to the former habitat, whereas the latter is occupied by *A. brevirostris*. Wherever the two species occur sympatrically in an arid situation, *A. brevirostris* is regularly the more "successful" and *A. distichus* the species whose

distribution is limited to favorable pockets within the area occupied by *A. brevirostris*. Such encounters (Thomazeau-Manneville; Haitian coast in the Jacmel area; arid coast on the north shore of the Golfe de la Gonâve) invariably are "unfavorable" for *A. distichus*. If the Ile de la Gonâve and the Península de Barahona were originally colonized by *A. brevirostris*, it seems likely that *A. distichus* may simply not have been able to penetrate into these regions to reach ecologically suitable habitats (shaded woods, oases, etc.) because of the previous presence there of *A. brevirostris*. The situation on Gonâve may be less complex, since as an off-shore island, Gonâve may never have been reached by *A. distichus*. On the other hand, it seems plausible, in the light of evidence from areas of contact between *A. brevirostris* and *A. distichus* elsewhere and the absence of *A. distichus* from the Península de Barahona, that *A. distichus* may not be able to compete with *A. brevirostris* on Gonâve where the latter species is already well established.

In summary, *A. distichus* has a wide distribution in the Bahama Islands and on Hispaniola, having arrived in the Bahamas directly from Hispaniola without employing either Cuba or the southern Bahamas as way stations. These two major segments of *A. distichus* have been isolated from one another for a sufficiently long period for some differentiation to have taken place between them, but in general they are similar. In the Bahamas, *A. d. distichus* is considered the basic stock whence have been derived four peripheral subspecies, of which one (*ocior*) was isolated on Rum Cay and San Salvador prior to the separation of the remaining three Bahaman races from *A. d. distichus*. On Hispaniola, *A. d. dominicensis* is suggested as a north island parent stock (whence the Bahaman races also were derived) which has invaded the south island. Previously, the terminal portion of the Tiburon Peninsula has received *A. distichus* across the Golfe de la Gonâve, and three subspecies had differentiated there. With the invasion of *A. d. dominicensis* across the inter-island strait, this subspecies came in contact with the easternmost (*aurifer*) of the Tiburon races. The subspecies in the Sierra de Baoruco (*favillarum*) is considered a relatively recent derivative from *dominicensis*. *A. d. tostus* on Isla Catalina suggests that there has been a westward shift in *A. distichus* populations along the southeastern coast, with the result that *tostus* is, alone of the four satellite island subspecies, unlike its neighbor on the adjacent mainland. The absence of *A. distichus* from Ile de la Gonâve and the Península de Barahona is attributed to the inability of *A. distichus* to compete with *A. brevirostris* in arid areas where the latter is well established.

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Ammonoids of the Late Scythian (Lower Triassic)

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AMMONOIDS OF THE LATE SCYTHIAN (LOWER TRIASSIC)

BERNHARD KUMMEL

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ABSTRACT

An evaluation of all taxa of ammonoids of the Late Scythian *Prohungarites* Zone shows the fauna to consist of 65 genera with 154 species. Of the total number of genera, 42 are confined to this zone, 20 genera are known to range up from the preceding *Columbites* and *Owenites* Zones, one genus is known from both older and younger horizons, and two genera are also present in the overlying Anisian. There are 24 genera endemic to the Tethyan region. The western Pacific, eastern Pacific, and Arctic faunas have only two endemic genera each. Indexes of faunal similarity between the major faunas of the *Prohungarites* Zone are presented. The largest number of genera of this zone is found in the Tethyan region. The Arctic region has only approximately 30 percent as many and the western and eastern areas an intermediate number. It is suggested that this is a true faunal gradient and could well reflect a climatic pattern.

The *Columbites* fauna lying immediately below that of the *Prohungarites* Zone is well known from southeast Idaho and Siberia, and appears to be present in Arctic Canada. This fauna is, as yet, not known in the Tethyan region. The *Columbites* fauna is closely related to that of the *Prohungarites* Zone.

INTRODUCTION

We are well along in the second century of the systematic study of invertebrate paleontology and stratigraphy. During the early phases of this period, published contributions consisted mainly of monographs describing the whole range of fossil forms, then known, for wide geographic regions. This initial pattern of publication was followed by a phase consisting mainly of monographs of faunas of specific stratigraphic units. This second phase gradually merged into a third where specific biological groups, with or without time restrictions, became the focal point of study. We are now in a fourth phase in the history of invertebrate paleontology where it is possible to attempt a total synthesis of animal groups on a world scale for relatively short units of time. The development of this latest phase in paleontology comes at a most appropriate time. Whereas there are still many areas that have received little or no intensive geological study, we do have a considerable fund of data from all parts of the world. In recent years there has developed a more intense interest in the problems of animal evolution and zoogeography. However, towards these goals invertebrate paleontology can make significant contributions only if a sound taxonomic base is present.

We are now in the midst of a great resurgence of interest in the question of permanence or non-permanence of the continents and oceanic basins, brought on primarily by the application of paleomagnetic studies. Paleontology must and can play

an important role in this fundamental re-evaluation of the earth's evolution. The importance of paleontological data to these problems is commensurate with the quality and quantity of data available. The vast majority of the paleontological data accumulated over the past century consists of faunal studies in which genera and species are treated as segregated elements with little or no relevance to other contemporaneous faunas. Syntheses which attempt to evaluate and re-appraise all generic and specific taxa on a global scale are not many. It is such syntheses, however, that will contribute most to the story of the earth's biological and physical history.

In an attempt to achieve a limited goal, I have set up a program to develop a three-dimensional picture of a stratigraphic stage based primarily on ammonites. For this purpose I have selected the Scythian Stage (Lower Triassic). The first requirement of this program is the establishment of a uniform taxonomic procedure based on consideration of all available data. This contribution is devoted to consideration of the two upper zones of the Scythian. In the chapter on systematic paleontology all taxa of Upper Scythian ammonoids are considered. These data provide the basis for the summary chapters concerning population structures, geographic distribution of species and genera, and other problems.

PLAN OF STUDY

The first described species of Lower Triassic (Scythian) ammonites was *Ammonites bogdoanus* von Buch (1831). The first century of study of Scythian ammonoids was focused primarily on documentation of each newly discovered fauna and on attempts to construct a zonal framework. It was recognized very early in the development of our geologic time scale that central and northern Europe were not appropriate areas to establish a chronological framework for the Triassic system based on a succession of marine faunas. The first attempt to establish a series, stage, and zonal scheme for the marine Triassic was by Mojsisovics, Waagen, and Diener (1895). It was in this paper that the term Scythian[1] was first introduced for the Lower Triassic, and the sequence of the Ceratite beds in the Salt Range of West Pakistan was selected as the type. At this time there had already appeared or were in an advanced stage of preparation Mojsisovics' monumental works on the Alpine Triassic (Mojsisovics, 1873–1902, 1882), Waagen's monograph of the Salt Range Ceratite bed fauna (Waagen, 1895), the faunas of the Lower Triassic of the Himalayas (Diener, 1897), the fauna of the Ussuri Bay (Primorye) region, and the Olenek fauna of northern Siberia (Mojsisovics, 1886, 1888). Thus, by the turn of the century, it was fairly well established that marine formations of Lower Triassic age existed in the Tethyan realm, in the circum-Pacific region and in the Arctic region.

Throughout the early period of study of Lower Triassic ammonoids, the primary guiding philosophy in taxonomy was typology. In fact, at that time there was no alternative—each fauna was new, small, and unique; the correlation of faunas was tenuous at best; and, finally, nomenclatural and species concepts were primitive or absent. The typological approach did facilitate description and comparison, and it led, in time, to a more complete documentation. One needs only to examine many original collections upon which the early classic studies were made, to have data on their collecting, and to know the prevailing geological and zoological philosophies, to appreciate why the faunas were treated as they were. Whereas one can understand and appreciate the guiding philosophies behind these early studies, it is quite clear that the resulting conclusions are not satisfactory for many purposes.

[1] The Scythians are an ancient nomadic tribe that occupied the area north of the Caspian Sea, the region which yielded *Ammonites bogdoanus*.

Table 1. Summary of numbers of species and specimens described in sixteen major publications on Lower Triassic (Scythian) ammonoids.

		Percent
Total species described	1194	
Species described on basis of 1 specimen	548	46
Species described on basis of 2 specimens	237	20
Species described on basis of 3 specimens	89	7.5
Species described on basis of 4 specimens	63	5
Species described on basis of 5 specimens	38	3
Species described on basis of 6–10 specimens	104	8.9
Species described on basis of 11–20 specimens	57	5
Species described on basis of >20 specimens	55	4.6

An analysis of the taxonomic treatment in 16 major publications on Lower Triassic (Scythian) ammonites is summarized in Table 1. These publications contain the description or documentation of 1,194 species of which 548 (46 percent) were based on a single specimen. In fact, only 216 species (18.5 percent) were based on 6 or more specimens. When one looks at only the new species described in these 16 monographs one gets a clearer insight into early taxonomic procedures. These data are summarized in Table 2. There are 668 new species of which 308 (46 percent) are based on a single specimen. Only 100 of these new species (15 percent) were based on 6 or more specimens.

Although at any one period there were usually only from one to four active workers on Lower Triassic ammonoids, a vast amount of geologic and paleontologic data was accumulated during a century or so of study. I believe we now are in a position to approach the problem as a whole and not in terms of isolated parts, as has been the pattern in the past. The first step in such a synthesis is a thorough restudy of all available type collections of the early classic studies. I have had the opportunity of studying the following faunas: the Werfen fauna described by Kittl (1903), deposited in the Natural History Museum, Vienna; the Albanian *Subcolumbites* fauna described by Arthaber (1908, 1911), deposited in the Paleontological Institute, University of Vienna; the *Subcolumbites* fauna of Chios described by Renz and Renz (1948), deposited in the Natural History Museum, Basel; the Lower Triassic faunas of Timor described by Welter (1922), deposited in the Paleontological Institute, Bonn, and at Delft; various collections from the U.S.S.R. described by Mojsisovics (1882, 1886), Popov (1961), and Kiparisova (1961); the Kashmir fauna, described by Diener (1913); the Himalayan fauna described by Diener (1897) and Krafft and Diener (1909), deposited in the Geological Survey of India, Calcutta; the fauna of the Lower Triassic of Spitsbergen deposited in the Paleontological Institute, Stockholm, and the Arctic Institute, Norway; the fauna of Arctic islands of Canada and British Columbia described by Tozer (1961a, 1965a, b) and deposited in the Geological Survey of Canada, Ottawa; the faunas of the western United States described by J. P. Smith (1932), deposited in the U.S. National Museum, Washington; and finally the large collections in the British Museum (Natural History). In addition I have had before me new collections made by myself in Nevada, Utah, Idaho, Madagascar, Afghanistan, and the Salt Range of West Pakistan. The only large fauna of Lower Triassic ammonites that I have not personally examined is that from south China, described by Chao (1950, 1959).

The examination of these many faunas allowed a direct comparison of related taxa. Many specimens, several of them types, had been inadequately, and in some cases

TABLE 2. SUMMARY DATA ON NUMBERS OF SPECIMENS ON WHICH NEW SPECIES WERE ESTABLISHED IN THE SAME SIXTEEN MAJOR PUBLICATIONS ON LOWER TRIASSIC (SCYTHIAN) AMMONOIDS AS TABULATED IN TABLE 1.

		Percent
Total new species	668	
Species established on basis of 1 specimen	308	46
Species established on basis of 2 specimens	137	20
Species established on basis of 3 specimens	55	8
Species established on basis of 4 specimens	42	6
Species established on basis of 5 specimens	25	4
Species established on basis of 6–10 specimens	48	7
Species established on basis of 11–20 specimens	28	4
Species established on basis of >20 specimens	24	4

misleadingly described or illustrated. The numbers of specimens in these collections vary greatly. In some, e.g. the Salt Range and Himalayan collections, only the figured specimens of the original monographs are available, whereas the *Subcolumbites* fauna of Chios, described by Renz and Renz (1948) and preserved in the Natural History Museum, Basel, is nearly twice as large as indicated in the original monograph.

In approaching the problem of evaluation and synthesis of all these faunas, I elected to study them zone by zone. In this paper I am treating the two upper zones of the Scythian, the *Prohungarites* Zone and the *Columbites* Zone. Rather than focus my studies on a fauna by fauna analysis, I chose to make the genus my unit of study. For each genus of late Scythian ammonoids, an analysis was made of all species and specimens that had been or should be assigned to it. For many of the genera there were usually one or more faunas which contained an appreciable number of specimens of a species, thereby yielding data on intraspecific variation. The insight gained from studies of species represented by large numbers of specimens was of great help in the analysis of species represented by one or very few specimens from other localities. In essence, the analysis of a population of many specimens provided the framework within which isolated specimens could be more logically interpreted. Essentially, none of the previous studies on these late Scythian ammonoids gave more than token tribute to the range of morphological variation in their species. Even though many of the faunas from single horizons and localities had yielded an abundance of certain taxa, emphasis was placed on "differences" rather than similarities. In many of these cases it can be clearly demonstrated that within the fauna, one is dealing with a highly variable single species complex rather than with a complex of several species of a genus. In most such cases species were differentiated on the basis of differing shell parameters, that is, degree of whorl compression, involution, suture, etc. Plots of measurements of large numbers of specimens often show the particular distinguishing parameters to be part of a gradational series.

The total numbers of specimens in nine faunas of the *Prohungarites* Zone and the numbers of specimens on which the species are based are summarized in Table 3. The numbers of species for each of these faunas are based on the results presented in the systematic portion of this paper. The number of species based on 20 or more specimens is relatively small. At the same time, these relatively few species include anywhere from 36 to 90 percent of the total number of specimens in these faunas.

It is thus quite apparent that only about 25 percent of the total number of species for the *Prohungarites* Zone have been established on the basis of samples of reason-

Table 3. Summary data on numbers of specimens and the numbers of specimens per species in nine major faunas of the *Prohungarites* Zone.

	Albania	Chios	China	Primorye	B. C.	Tobin	Timor	Ellesmere Is.	Hammond Cr.
Total specimens in collection	730	1900	97	97	41	186	24	23	296
No. of species in fauna	32	41	21	17	11	7	11	5	11
No. of species with 50 specimens	5	9	0	0	0	2	0	0	1
Percentage of total specimens	53.4	49.0	0	0	0	53.7	0	0	67.5
No. of species with 20–49 specimens	6	9	0	1	0	2	0	0	2
Percentage of total specimens	27.8	12.5	0	36.2	0	34.7	0	0	23.6
No. of species with 10–19 specimens	7	3	2	0	1	1	0	1	0
Percentage of total specimens	15.0	2.4	26.7	0	36.5	5.4	0	47.8	0
No. of species with 5–9 specimens	1	7	6	6	2	1	1	1	2
Percentage of total specimens	0.7	2.6	43.3	41.2	31.7	3.7	25	26.1	6.0
No. of species with 1–4 specimens	13	13	13	10	8	1	10	3	6
Percentage of total specimens	3	1.5	30	22.6	31.7	2.2	75	26.1	2.7

able size. Note the difference in these figures from those given in Tables 1 and 2. Species based on few specimens are difficult to evaluate. If two or more species are based on few specimens from the same horizon and locality and are differentiated on criteria known to be highly variable in related groups, I have tended to synonymize them. The prime assumption is that a larger sample would "fill in" the morphological gap with gradational forms. However, species based on few specimens from widely separated localities are generally kept separate even though there is a strong indication that they may be identical with other named species.

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LOWER TRIASSIC CHRONOLOGY

The name Scythian was first introduced as a series name for the Lower Triassic by Waagen and Diener *in* Mojsisovics, Waagen, and Diener (1895); the sequence for the Salt Range of West Pakistan was selected as the type, with the addition of the *Otoceras woodwardi* Zone of the Himalayas at the base of the sequence (Table 4).

TABLE 4. ZONAL SCHEME FOR THE LOWER HALF OF THE TRIASSIC SYSTEM FOR THE TETHYAN REALM SUGGESTED BY MOJSISOVICS, WAAGEN, AND DIENER (1895).

Series	Stage	Substage	Mediterranean Trias Province		Indian Trias Province		
			Zone Tethyan facies	Formations	Zone Tethyan facies	Formations	
Dinarian	Anisian	Bosnian	Zone of *Ceratites trinodosus*	U. Muschelkalk	Zone of *Ptychites rugifer*	Muschelkalk of the Himalayas	
		Balatonian	Zone of *Ceratites binodosus*	L. Muschelkalk	Zone of *Sibirites prahlada*	Beds with *Rhynchonella griesbachi* in the Himalayas	
	Hydaspian				8. Zone of *Stephanites superbus*	Upper Ceratite limestone, Salt Range	
Scythian	Jakutian		Zone of *Tirolites cassianus*	Werfen Beds	7. Zone of *Flemingites flemingianus*	Ceratite sandstone, Salt Range	Subrobustus beds, Himalayas
					6. Zone of *Flemingites radiatus*		
					5. Zone of *Ceratites normalis*		
	Brahmanian	Gandarian		Eastern Alps	4. Zone of *Proptychites trilobatus*	Ceratite marls, Salt Range	
					3. Zone of *Proptychites lawrencianus*		
					2. Zone of *Gyronites frequens*	Lower Ceratite limestone, Salt Range	
		Gangetian			1. Zone of *Otoceras woodwardi*	Otoceras beds, Himalayas	

Table 5. Zonal scheme for the Lower Triassic (Scythian) proposed by Spath (1930).

		Ages	Zones (India)	Some Equivalents
EO-TRIAS	Upper	Stephanitan Columbitan		*Arctoceras* beds, Spitsbergen; *Olenekites* beds, N. Siberia.
			superbus?	*Columbites* beds, Albania; *Anasibirites* beds, Spitsbergen, Utah, Timor; *Tirolites* beds, Werfen.
		Owenitan		*Meekoceras* beds, California.
			flemingianus	*Meekoceras* beds, Timor;
			volutus	*Hedenstroemia* beds, Himalayas (lower part).
	Lower	Flemingitan		
			fallax	"*Ophiceras*" beds, Timor.
		Gyronitan	*rotundatus*	"*Meekoceras*" beds, Himalayas.
			radiosus	*Proptychites* beds, Primorye.
				Proptychites beds, Greenland.
		Otoceratan	*woodwardi*	*Otoceras* beds, Greenland.

The Scythian was thus proposed as a series division which included seven ammonoid zones, but the zonal context of the Scythian has since undergone considerable change. What is so puzzling is that Waagen and Diener separated from the Scythian the fauna of the Upper Ceratite limestone (zone of *Stephanites superbus*) of the Salt Range, establishing a new stage (Hydaspian) of the Middle Triassic. This was done on the basis of what they interpreted as a striking change between the faunas of the Upper Ceratite limestone and the underlying members of the Ceratite beds. The basis of Waagen and Diener's correlation of these divisions was summarized as follows: "Es kann wohl nicht in Zweifel gestellt werden, dass die tieferen Abteilungen der Ceratiten-Schichten als zeitliche Aquivalente jener Bildungen anzusehen seien, welche in Mittel-Europa den Namen 'Buntsandstein' tragen. Anderseits jedoch haben wir gesehen, dass angefangen von den tiefsten Ablagerungen des Lower Ceratite Limestone bis hinauf zur oberen Grenze der Ceratite Sandstones eine kontinuierliche Serie der Cephalopoden-Faunen angetroffen wird, dass aber vom Ceratite Sandstone zum Upper Ceratite Limestone ein betrachtlicher Wechsel sich einstellt. Hier muss also eine Formationsgrenze durchgezogen werden, und diese Grenze kann nur jene zwischen der Skythischen und Dinarischen Serie sein.

Wir glauben daher die Oberen Ceratiten-Kalke an die Basis der Dinarischen Serie stellen zu sollen und betrachten sie innerhalb der letzteren als den Typus einer besonderen Stufe. Die Bezeichnung der letzteren als Hydaspische Stufe ist dem alten Namen des die Salt Range an ihrer Ostseite umfliessenden Ihelum (Hydaspes) entnommen" (Mojsisovics, Waagen, and Diener, 1895:1291). This scheme of classification was completely accepted by Smith (1896, 1901, 1904).

Noetling (1901, *in* Frech 1905) interpreted the fossiliferous Triassic beds of the Salt Range (through the zone of *Stephanites superbus* of the Upper Ceratite limestone) as including a complete succession of faunal zones for the Scythian. This view was held by Diener (1912:256), Welter (1922:92), and others.

This view on the age span of the Ceratite beds and the scope of the Scythian stage generally prevailed until Spath (1930:76) published a preliminary scheme for the subdivisions of the Scythian (Table 5). This is an extremely interesting modification of the earlier attempt to establish subdivisions of the Scythian. This scheme differed in detail from the proposals and conclusions of previous authors, but it agreed with

TABLE 6. ZONAL SCHEME FOR THE UPPER HALF OF THE LOWER TRIASSIC (SCYTHIAN) PROPOSED BY SPATH (1934).

	Divisions	Zones	Equivalents
Upper Eo-Trias	Prohungaritan (Olenikitan ?)		Upper *Arctoceras* beds, Spitsbergen. Olenek beds, Siberia (*partim*). *P. middlemissi* beds, Kashmir.
	Columbitan	*Columbites* *Tirolites*	*Subcolumbites* beds, Albania, Timor. *Columbites* beds, Idaho. *Tirolites* beds, Alps, etc., Idaho.
	Owenitan	*Anasibirites*	*Anasibirites* beds, Timor, Utah. Chocolate Limestone, Byans? Upper Ceratite Limestone, Salt Range. *Kashmirites* beds, Kashmir, Timor.
		Owenites *Pseudosageceras*	*Meekoceras* beds, Timor, Idaho, California. Timor, Himalayas, W. America.

several of these in having a single zone (*Stephanites superbus*) to represent most of the upper Scythian. At the same time, within the late Scythian, Spath (1930:76) recognized three ages: the Owenitan, Columbitan, and Stephanitan.

Spath's proposal was admittedly a tentative scheme in need of further analysis. What was critically lacking, especially for the upper part of the scale, were sufficient stratigraphic sections with these faunal zones in sequence. Spath was cognizant that Smith (1904), Hyatt and Smith (1905), and Smith (1914) had reported Scythian ammonoid faunas in sequence in southeastern Idaho, but published data were very limited. Smith's (1932) monograph on the Lower Triassic ammonoids of North America provided a comprehensive treatment of these ammonoid faunas. In southeastern Idaho, Smith encountered within the Thaynes Formation a sequence of three ammonoid zones which formed the basis for the upper part of his chronologic scheme for the Lower Triassic:

Columbites Zone
Tirolites Zone
Meekoceras Zone
- *Anasibirites* Subzone
- *Owenites* Subzone
- *Pseudosageceras multilobatum* Subzone

As my own monograph is devoted to the ammonoid faunas of the upper Scythian, no further discussion is needed here in regard to the zones of lower Scythian. A comprehensive discussion of the *Meekoceras* Zone has been published by Kummel and Steele (1962), and Kummel and Erben (1968).

Smith considered his *Anasibirites* Subzone to be equivalent to the fauna of the Upper Ceratite limestone of the Salt Range. Smith furthermore considered the specimen (presumably from the topmost limestone of the Dolomite beds) that Waagen (1895: 130, pl. 21, figs. 1a–c) described as *Pseudharpoceras spiniger* as allied to his own species, *Pseudharpoceras idahoense*, from the *Columbites* fauna of southeast Idaho, and thus of *Columbites* Zone age. This scheme enlarged the scope of the Scythian.

Smith's zonal scheme and analysis of the Scythian came under the searching pen of L. F. Spath (1933, 1934). Though Spath was rather caustic in his remarks on Smith's zonal scheme, the differences between these two authorities were not that extensive. Spath presented a new scheme of zones and correlations in 1934; that for the upper half of the Scythian is shown on Table 6. It can readily be seen that this zonal scheme differs from that proposed by Smith (1932) mainly in the introduction of a division of one or more zones above the Columbitan. In this conclusion Spath was guided mainly by "intuition," which was

supported by the biologic character of the faunas. Stratigraphic data on the faunas he assigned to his Prohungaritan division were either completely lacking or very ambiguous. In his conclusions, explaining the significance of the Prohungaritan division, Spath (1934:34) states: "I am merely relying on the obvious differences between the lowest Anisian and the highest Scythian faunas so far known, and the only difficulty is to find a name for this time interval that will prove sufficiently accurate to serve for a label, even if it is not the best that could ultimately be proposed." Spath's conclusions regarding additional zones above the *Columbites* Zone were verified with the discovery of a *Prohungarites* fauna in the Thaynes Formation of southeast Idaho, 1,000 feet above the *Columbites* fauna (Kummel, 1954).

In recent years a number of additional localities have been studied which have yielded sequences of ammonoid faunas in upper Scythian formations. Aside from southeastern Idaho, good stratigraphic sections with fossil faunas are now known for Ellesmere Island (Tozer, 1961a, 1965a), the Primorye Region around Vladivostok (Kiparisova, 1961; Zakharov, 1966), Kwangsi, China (Chao, 1959), the Salt Range of West Pakistan (Kummel, 1966), and Afghanistan (Kummel, 1968). In southeast Idaho, Utah, Ellesmere Island, Primorye Region, and northern Siberia, the upper Scythian comprises a sequence of three distinctive faunas: the *Owenites* (or *Meekoceras*) fauna, the *Columbites* fauna, and at top the *Prohungarites* fauna or its equivalents. The *Columbites* fauna is not known from south China, West Pakistan, or Afghanistan. Other areas that have yielded faunas of *Prohungarites* Zone age but are isolated in having no other Scythian ammonoid faunas above or below are those of the Werfen Formation of southeast Europe, Albania, Chios, Mangyshlak Peninsula, Kashmir, Timor, New Zealand, Japan, and Nevada (Tobin Formation).

Even though there has been a vast increase in the amount of data on Scythian strata and faunas over the past decade, considerable differences of interpretation on the correlation of late Scythian zones persist. Kiparisova and Popov (1956) rejected Spath's (1934) Prohungaritan division and accepted Columbitan as the latest Scythian biostratigraphic unit. They considered this division as including the *Olenekites* fauna of northern Siberia, the *Subcolumbites* fauna of the Primorye Region, Albania, and Chios, and the *Arctoceras* fauna of Spitsbergen. At a later date these two authors (Kiparisova and Popov, 1961) modified their late Scythian chronology and accepted a *Prohungarites* Zone as the latest Scythian zone, overlying a *Columbites* Zone. Their *Prohungarites* Zone was then stated to include the following faunas: *Prohungarites middlemissii* of Kashmir, the *Prohungarites* fauna of southeast Idaho, the *Olenekites* fauna of northern Siberia, and *Subcolumbites* fauna of the Primorye Region, Albania and Chios, the *Procarnites-Leiophyllites* fauna of Kwangsi, China, and the *Stacheites* Zone of Astakhova (1962) of the Mangyshlak Peninsula. Later, these authors introduced a further revision (Kiparisova and Popov, 1964) in the correlation of late Scythian faunas. They now considered the *Olenekites* fauna of northern Siberia, as well as the *Subcolumbites* fauna of the Primorye Region, as being of *Columbites* Zone age. The correlations of the *Prohungarites* Zone included a new but undescribed *Prohungarites* element from northern Siberia, a questionable *Prohungarites* from the Primorye Region, the Kashmir *Prohungarites middlemissii*, the *Prohungarites* fauna of southeast Idaho, and the *Procarnites-Leiophyllites* faunas of Kwangsi, China.

Our knowledge of the Scythian of China greatly increased with the appearance of a large monograph by Chao (1959) on faunas from Kwangsi. Chao followed the lead of Kiparisova and Popov (1956) in using the Columbitan division to encompass all of the late Scythian. For Kwangsi Province,

Chao recognized three zones within his Columbitan division, namely:

Procarnites-Leiophyllites Zone
Columbites costatus Zone
Tirolites darwini Zone

The paleontology and stratigraphy of these Kwangsi faunas are discussed in detail on page 351. It will suffice here to summarize my conclusions. The *Tirolites darwini* Zone was recognized from a single, fragmentary specimen from an isolated horizon. This specimen is not well enough preserved to be identified. The name-giving species of the second zone, *Columbites costatus*, is a synonym of *Prenkites timorensis*. The fauna listed as comprising the *Procarnites-Leiophyllites* Zone was derived from loose blocks. The assemblage of species and genera which were assigned to the *Columbites costatus* Zone and the *Procarnites-Leiophyllites* Zone are such that one can only conclude they are part of a single zone. Recent contributions by Tozer (1961a, 1965a, b) have shown that British Columbia and the Arctic islands have faunal sequences comparable to those of southeast Idaho.

Late Scythian faunas lying in stratigraphic position above the mid-Scythian *Owenites* Zone are now known from nine localities. In Afghanistan a *Subcolumbites* fauna occurs immediately above an *Owenites* fauna (Kummel, 1968) and the same situation is present in the Salt Range and Surghar Range of West Pakistan (Kummel, 1966) and in Kwangsi Province of south China (Chao, 1959). In the Primorye Region the *Subcolumbites* fauna is stratigraphically above a *Columbites* fauna which in turn lies above an *Owenites* fauna. In northern Siberia the *Olenekites* fauna occurs above a *Columbites* fauna which, in places, lies above an *Owenites* fauna. The same is true for Ellesmere Island. In southeastern Idaho the uppermost Scythian is marked by a *Prohungarites* fauna, which, in turn, is underlain by a *Columbites* fauna and this by an *Owenites* fauna. The *Tirolites* Zone of Smith (1932) is of only local importance and not equivalent to the fauna of the Werfen Formation (see p. 342).

We thus have a sequence of two faunas (*Columbites* and *Prohungarites*) above the mid-Scythian *Owenites* Zone in southeast Idaho, Ellesmere Island, and the Primorye Region and in northern Siberia. However, in China, West Pakistan, and Afghanistan, wherever we have stratigraphic control, the late Scythian *Subcolumbites* or *Prohungarites* fauna lies directly above *Owenites* Zone faunas. This raises a question as to the relationships of the *Columbites* fauna and its independence as a zonal entity.

The *Columbites* fauna and its equivalents are known from southeast Idaho, the Primorye Region and northern Siberia. There are 21 genera of ammonoids in one or another of these three main faunas. The largest number of genera (15) comprise the *Columbites* fauna of southeast Idaho. The Primorye Region contains eight genera and northern Siberia six genera at this horizon. Of the total of 21 genera, only two are restricted to this horizon. Two genera are also present in earlier horizons, seven genera are present in both older and younger horizons, and ten genera are also present in younger horizons. There are no species in common in the faunas assigned to the *Columbites* Zone and those assigned to the *Prohungarites* Zone, but the ten genera in common include such late Scythian members as *Procolumbites, Pseudoceltites, Svalbardiceras, Metadagnoceras, Nordophiceras, Keyserlingites, Olenekites, Hellenites, Dalmatites*, and *Ussurites*.

The faunas assigned to the *Columbites* Zone clearly are intimately related to those assigned to the *Prohungarites* Zone and are quite distinct from the faunas of the *Owenites* Zone. Zakharov (1966) expressed this relationship by treating the two faunas as subzones of a single late Scythian Zone. There is no question but that this suggestion has merit. However, at a species level, these two successive faunas are very dis-

tinct. The bothersome factor is the absence of the *Columbites* Zone in Tethys. This, however, may be due more to preservation than to anything else. Only eight areas within Tethys have yielded late Scythian faunas. The *Subcolumbites* faunas of Albania and Chios are isolated, without other Scythian faunas above or below. The Werfen fauna and that from the Mangyshlak Peninsula are from semi-isolated embayed regions along the northern margin of Tethys and contain a large percentage of endemic genera and species and are the youngest Scythian ammonoid faunas in their respective areas. The Kashmir record is based on specimens found as float. There are thus only two areas within Tethys where a sequence of two ammonoid zones, *Prohungarites* over *Owenites*, is known. These occur at Kotal-e-Tera, Afghanistan, and in the Salt Range and Surghar Range of West Pakistan. At Kotal-e-Tera the Scythian comprises approximately 90 feet of limestone and dolomite of which 75 feet includes an *Owenites* fauna and the upper 15 feet contains a *Prohungarites* Zone fauna. Ammonoids are abundant and fairly well preserved in the *Owenites* Zone, but the fossils from the *Prohungarites* Zone are neither common nor well preserved. In the Salt Range and Surghar Range of West Pakistan the *Prohungarites* Zone is thought to comprise all of the Narmia Member of the Mianwali Formation (Kummel, 1966). Fossils in the Narmia Member are very scarce and not well preserved. The lowest units of the Narmia Member, which includes the Bivalve Limestone of Waagen (1895), contain *Nordophiceras planorbis* (Waagen) and *Xenoceltites sinuatus* (Waagen). These two species could possibly be of *Columbites* Zone age, but because of scarcity and generally poor preservation of the Narmia Member fossils one cannot be sure.

A new area of Permian and Triassic outcrops has been reported by Sokolov and Shah (1965) around Ghazaband Pass, Quetta District, West Pakistan. The presence of the Scythian in this region is based on a single specimen identified by Mr. A. N. Fatmi of the Geological Survey of Pakistan as *Columbites* sp. The formation which yielded this specimen comprises 300–500 meters of shale with thin interbeds of limestone. It is unfortunate that this specimen has neither been described nor illustrated.

The absence of a *Columbites* Zone fauna in Kwangsi, China, may be due to facies differences or possibly to insufficient field studies. There is obviously a great need for more data, but on the basis of the picture developed here, I advocate considering the *Columbites* and *Prohungarites* Zones as closely related but distinct; the absence of the *Columbites* fauna in Tethys and south China is most likely due to collection failure and/or adverse facies for preservation.

The nomenclature of these late Scythian zones presents problems. The *Columbites* Zone seems fairly well established. The name-giving species, *Columbites parisianus*, is present at the type locality in Paris Canyon, southeast Idaho, in the Primorye Region, and possibly in Arctic Canada. The presence of *Columbites parisianus* in the Primorye Region makes it difficult to understand why Zakharov (1966) selected a different species to identify this zone. *Columbites* is not present in northern Siberia, but the genera and species of Popov's *Dieneroceras* Zone are very close to those in the *Columbites* fauna of southeast Idaho.

The naming of the Scythian post-*Columbites* Zone has not been settled to everyone's satisfaction, mainly because of erroneous views concerning composition of the faunas and their correlation. Spath (1934) was the first to clearly recognize the need for a unit (or zone) above that of *Columbites*. For this upper unit he introduced the Prohungaritan Division, with the following comment: "On the other hand, the uppermost beds of the Eo-Trias are as yet very incompletely known, and

the use of the term Prohungaritan (or Olenikitan) is provisional, for the *Olenikites* especially may yet be found to belong to the Columbitan, together with *Keyserlingites*, although its derivative *Durgaites* is a characteristic element of the Lower Anisian" (Spath, 1934:32, 33). We now have a much larger fund of data than was available to Spath. There is no longer any question as to the need for an additional zone above that of *Columbites*, but at the same time I conclude that only one such zone is present world wide. To be sure, there are areas where several local zones are present, e.g. Mangyshlak Peninsula, but these are only parts of a global zone.

There is only one species of ammonite in the late Scythian that is world wide in distribution—*Pseudosageceras multilobatum*. However, a number of genera and even species have very widespread distribution. Such forms and their patterns of overlapping associations provide the key for definition of a global late Scythian Zone. Within Tethys there is a fairly homogeneous fauna characterized by such forms as *Subcolumbites*, *Albanites*, and *Prohungarites*. These Tethyan faunas have a high degree of similarity with faunas from the western and eastern Pacific regions. There is much less similarity with the faunas of the circum-Arctic region. However, the presence of several genera which are particularly characteristic of the circum-Arctic region within faunas of the western and eastern Pacific and in Tethys offers the opportunity to make a correlation. For this latest zone of the Scythian I feel we should retain the name *Prohungarites* as originally, though tentatively, suggested by Spath (1934). There is surely much that remains to be known about late Scythian ammonites, but on the basis of the available data, I see no need to introduce changes in Spath's nomenclature. The genus *Prohungarites* is now known to be widely distributed in the Tethyan, Pacific and Arctic realms. The large number of forms associated with *Prohungarites* makes correlation of faunas in which it is not present relatively easy.

Wright (in Ager and Nichols, 1963) has suggested an interesting base upon which to develop a logical picture of the spatial relationships of the many late Scythian faunas now known. Evidence is mounting that ammonites were gregarious and perhaps had distinct paths of migration, possibly as part of the breeding process. The modification and superimposing of gregarious swarms could lead to the kinds of assemblages that are encountered in these late Scythian faunas. The faunas of the Werfen Formation and the Mangyshlak Peninsula, with their large component of endemic genera and species, are clearly geographic isolates developed in embayments off the margin of Tethys.

Few precise radiometric dates are available for the Triassic (Harland, et al., 1964). Holmes (1959) assigned a period of 45 million years, and Kulp (1961) 49 million years to the Triassic; thus it seems reasonable to conclude that the Scythian had a duration of possibly 7 to 10 million years. Within the Scythian there exist most probably only five or six world-wide zones. This suggests a duration of approximately 1 to 2 million years for each zone.

A few comments are appropriate regarding the use of Scythian as the stage name for the Lower Triassic in light of recent attempts to introduce other names. The history of the name Scythian has already been discussed (p. 313). The name has had general acceptance as the stage name for the Lower Triassic ever since the term was introduced in 1895. The term is well entrenched in the paleontological literature, works on regional geology, text-books, etc. In recent years proposals have been made to abandon the term Scythian and replace it with two or four new stage names. Some of these proposals were clearly intended for use within a particular country, others were hopefully proposed for wider application. For instance, in New Zealand there has been a general abandonment of European stage names, and a new classification

specifically adapted to the New Zealand stratigraphic panorama is used. The local stages are then correlated with the European stages. Ammonites are not common in Triassic formations of New Zealand; pelecypods and brachiopods are more common and play a greater role in the definition of the local stages. It should be noted that the Triassic ammonites, known to date, are genera common to faunas of Tethys and the circum-Pacific region. A somewhat similar approach to Triassic chronology has been proposed by Ichikawa (1950, 1956) for Japan. This system of classification has not been generally adopted in Japan.

Kiparisova and Popov (1956, 1961, 1964) in a series of papers have proposed abandonment of Scythian as the stage name for the Lower Triassic and the substitution of two new stage names, the Indian and the Olenekian. The lower of these stages, the Indian, derives its name from the Indus River, and the upper, the Olenekian, from the Olenek beds of the Olenek River region, northern Siberia. These two stages are equivalent to the Lower Eo-Trias and Upper Eo-Trias of Spath (1934); the boundary of the stages was placed between the Flemingitan and Owenitan divisions of Spath. In a later contribution on this subject Kiparisova and Popov (1964) altered the spelling of their stage names to Indus and Olenek and lowered the boundary between the zones. These authors concluded that the ammonites of the *Flemingites flemingianus* Zone are really equivalent to the *Owenites* Zone; thus the upper zone for the Indus stage at its type locality in the Salt Range is the zone of *Koninckites volutus* which these authors placed within the *Gyronites* Zone.

The most recent contribution of new stage names for the Lower Triassic of Canada is by E. T. Tozer (1965b). This author proposes for use in Canada four stages: Griesbachian, Dienerian, Smithian, Spathian. Tozer had the cooperation of the Canadian Permanent Committee on Geographical Names in establishing names of creeks in Arctic Canada after these prominent Triassic paleontologists. The type areas of these new stages are based on sequences in Ellesmere and Axel Heiberg Islands.

The presumed justification for establishing these new stage names is to clarify communication. Local stage names under certain circumstances are useful. However, they tend to be based on incomplete data and approached from a provincial point of view. We need only look back at the history of development of the geological time scale to see the bad effects of the proliferation of stage names for certain systems and the resultant confusion. One would think we had reached a stage of maturity in the science where repetition of this sort of thing would not take place.

SUMMARY OF *PROHUNGARITES* ZONE AMMONOIDS

The ammonoids of the *Prohungarites* Zone, as here understood, comprise 65 genera with 154 species (Table 7). Of the total number of genera, 42 are confined to this zone, 20 genera are known to range up from the preceding *Columbites* and *Owenites* zones, one genus is known from both older and younger horizons, and 2 genera are also present in the overlying Anisian. The geographic distribution of the genera is summarized in Table 8. Twenty-four genera, or 36.9 percent of the fauna, are confined to a single locality or region; 10 genera, or 15.4 percent of the fauna are known from two localities. Thus 52.2 percent of the total fauna of 65 genera are known from only one or two localities. On the other hand, only 10 genera, or 15.4 percent, are known from 6 to 11 localities or regions. The degree of geographic restriction of genera is of particular interest. There are 24 genera endemic to the Tethyan region, that is, known only from one or two localities within Tethys. However, the western Pacific, eastern Pacific, and Arctic faunas have only two endemic genera each.

TABLE 7. SUMMARY TABLE OF GENERA AND SPECIES OF AMMONITES AND THEIR GEOGRAPHIC DISTRIBUTION IN THE *PROHUNGARITES* ZONE. SYMBOLS USED IN RIGHT HAND COLUMN (RANGE OF GENERA AND SPECIES) ARE AS FOLLOWS: × = PRESENT ONLY AT THIS HORIZON, — = PRESENT IN BOTH YOUNGER AND OLDER HORIZONS, e = PRESENT ALSO IN EARLIER HORIZONS, l = PRESENT ALSO IN LATER HORIZONS.

	Werfen Formation (Alps to Bulgaria)	Albania (*Subcolumbites* fauna)	Chios (*Subcolumbites* fauna)	Mangyshlak Peninsula	Afghanistan (*Subcolumbites* fauna)	Salt & Surghar Ranges West Pakistan	Kashmir (*Prohungarites* fauna)	Timor (*Prohungarites* fauna)	New Zealand	Kwangsi, China (*Subcolumbites* fauna)	Japan (*Subcolumbites* fauna)	Primorye Region (*Subcolumbites* fauna)	Olenek Region (*Olenekites* fauna)	Spitsbergen (*Keyserlingites* fauna)	Ellesmere Island (*Keyserlingites* fauna)	British Columbia (Toad-Grayling Fm.)	Providence Range California	Humboldt Range Nevada	Tobin Range Nevada	Confusion Range Nevada	Southeast Idaho (*Prohungarites* fauna)	Range of genera and species
Sageceratidae																						
Pseudosageceras																						e
multilobatum		×	×	×	×	×		×				×	×						×	×		e
drinense		×	×																		×	×
albanicum		×	×																			×
pasquayi			×																			×
simplex												×										×
Cordillerites																						e
angulatus		×	×							×						×						e
Dieneroceratidae																						
Dieneroceras																						e
mediterranea		×	×																			×
skutarensis		×	×																			×
karazini												×										×
Subvishnuites					×	×																e
enveris		×																				×
Hemilecanites																						×
discus		×	×							×												×
paradiscus																			×			×
Xenoceltidae																						
Xenoceltites					×								×									e
sinuatus						×																×
crenoventrosus										×												×
spitsbergensis												×										e
Preflorianites																						e
sulioticus		×	×																			×
garbinus			×																			×
multiplicatus													×									×
intermedius																×						×
Proptychitidae																						
Proptychitoides																						×
decipiens		×	×																			×
trigonalis		×	×																			×
arthaberi								×														×
tunglanensis										×												×
kummeli													×									×
Procarnites																						×
kokeni		×	×	×	×	×		×		×												×
immaturus												×				×						×
lolouensis										×												×
Paranannitidae																						
Arnautoceltites																						×
mediterraneus		×	×																			×
bajarunasi				×																		×
involutus										×												×
gracilis												×										×
teicherti																			×			×
Prosphingites																						e
czekanowskii													×			×						×
ali		×																				×
lolouensis										×												×
subglobosus										×												×
globosus												×										×
insularis												×										×
coombsi									×													×

TABLE 7. *Continued*

	Werfen Formation (Alps to Bulgaria)	Albania (*Subcolumbites* fauna)	Chios (*Subcolumbites* fauna)	Mangyshlak Peninsula	Afghanistan (*Subcolumbites* fauna)	Salt & Surghar Ranges West Pakistan	Kashmir (*Prohungarites* fauna)	Timor (*Prohungarites* fauna)	New Zealand	Kwangsi, China (*Subcolumbites* fauna)	Japan (*Subcolumbites* fauna)	Primorye Region (*Subcolumbites* fauna)	Olenek Region (*Olenekites* fauna)	Spitsbergen (*Keyserlingites* fauna)	Ellesmere Island (*Keyserlingites* fauna)	British Columbia (Toad-Grayling Fm.)	Providence Range California	Humboldt Range Nevada	Tobin Range Nevada	Confusion Range Nevada	Southeast Idaho (*Prohungarites* fauna)	Range of genera and species
Vickohlerites					×																	×
sundaicus		×						×														×
Zenoites																						×
helenae			×																			×
vonderschmitti			×																			×
arcticus																×						×
Isculitoides					×	×																×
originis		×	×					×														×
ellipticus										×												×
suboviformis												×										×
minor																×						×
wasserbergi																			×			×
hammondi																					×	×
Chiotites																						×
globularis			×																			×
Czekanowskites																					×	×
decipiens													×									×
Popovites																						×
occidentalis																×						×
borealis															×							×
Monocanthites																						×
monoceras																×						×
Tunglanites																						×
lenticularis										×												×
alexi		×	×																			×
Subcolumbites																						×
perrinismithi		×	×		×					×	×											×
dusmani		×	×																			×
robustus										×												×
multiformis												×										×
americanus																			×			×
Paradinarites																						×
suni										×												×
Pseudoceltites																						e
dolnapaensis				×																		×
nevadi																				×		×
Procolumbites																						×
karataucikus				×																		×
Prenkites												×										×
malsorensis		×	×																			×
helenae			×																			×
timorensis			×					×		×												×
Protropites																						×
hilmi		×																				×
Chioceras																						×
mitzopouloi			×																			×
nodosum			×																			×
Arianites																						×
musacchi		×																				×
Meropella					×																	×
plejanae			×																			×
Epiceltites																						×
gentii		×	×																		×	×
subgracilis				×																		×
Ussuriidae																						
Parussuria																						e
latilobata										×												×
Hedenstroemiidae																						
Metahedenstroemia																						×
kastriotae		×	×																			×

TABLE 7. *Continued*

	Werfen Formation (Alps to Bulgaria)	Albania (*Subcolumbites* fauna)	Chios (*Subcolumbites* fauna)	Mangyshlak Peninsula	Afghanistan (*Subcolumbites* fauna)	Salt & Surghar Ranges West Pakistan	Kashmir (*Prohungarites* fauna)	Timor (*Prohungarites* fauna)	New Zealand	Kwangsi, China (*Subcolumbites* fauna)	Japan (*Subcolumbites* fauna)	Primorye Region (*Subcolumbites* fauna)	Olenek Region (*Olenekites* fauna)	Spitsbergen (*Keyserlingites* fauna)	Ellesmere Island (*Keyserlingites* fauna)	British Columbia (Toad-Grayling Fm.)	Providence Range California	Humboldt Range Nevada	Tobin Range Nevada	Confusion Range Nevada	Southeast Idaho (*Prohungarites* fauna)	Range of genera and species
Beatites																						×
berthae		×																				×
Lanceolites																						e
discoidalis	×																					×
Meekoceratidae																						
Svalbardiceras						×															×	e
spitzbergensis														×								×
schmidti													×	×								×
sibiricum													×									×
dentosus													×									×
freboldi															×							×
chowadei																×						×
Stacheites						×															×	×
prionoides	×			×																		×
floweri																			×			×
Dagnoceras						×																×
nopcsanum		×																				×
zappanense		×						×														×
latilobatum										×												×
ellipticum										×												×
Metadagnoceras																						e
pulcher																×						×
tobini																			×			×
freemani								×														×
terbunicum		×	×																			×
Balkanites																						×
tabulatus	×																					×
Nordophiceras																						e
pseudosimplex													×									×
planorbis						×																×
compressum										×												×
Pseudokymatites																						×
svilajanus	×																					×
Arctomeekoceras						×																×
rotundatum													×									×
Boreomeekoceras																						×
keyserlingi													×									×
Arctotirolites																						×
menensis													×									×
Noritidae																						
Albanites																						×
triadicus		×	×	×	×			×														×
Sibiritidae																						
Sibirites																						×
eichwaldi													×									×
renzi			×																			×
Keyserlingites					×																	e
subrobustus													×	×	×	×						×
middendorffi													×									×
bearlakensis																					×	×
bearriverensis																					×	×
Olenekites																					×	e
spiniplicatus													×									×
mangyshlakensis				×																		×
canadensis															×							×
Eukashmirites																						×
subdimorphus				×																		×
contortus				×																		×
Anakashmirites						×																e

TABLE 7. *Continued*

	Werfen Formation (Alps to Bulgaria)	Albania (*Subcolumbites* fauna)	Chios (*Subcolumbites* fauna)	Mangyshlak Peninsula	Afghanistan (*Subcolumbites* fauna)	Salt & Surghar Ranges West Pakistan	Kashmir (*Prohungarites* fauna)	Timor (*Prohungarites* fauna)	New Zealand	Kwangsi, China (*Subcolumbites* fauna)	Japan (*Subcolumbites* fauna)	Primorye Region (*Subcolumbites* fauna)	Olenek Region (*Olenekites* fauna)	Spitsbergen (*Keyserlingites* fauna)	Ellesmere Island (*Keyserlingites* fauna)	British Columbia (Toad-Grayling Fm.)	Providence Range California	Humboldt Range Nevada	Tobin Range Nevada	Confusion Range Nevada	Southeast Idaho (*Prohungarites* fauna)	Range of genera and species
Tirolitidae																						
Tirolites						×														×		e
idrianus	×	×																				×
cassianus	×			×																		×
cingulatus	×																					×
rossicus				×																		×
impolitus				×																		×
morpheos													×									×
Diaplococeras																						×
liccanum	×																					×
connectens	×																					×
Bittnerites																						×
bittneri	×																					×
Doricranites																						×
bogdoanus				×																		×
acutus				×																		×
Dinaritidae																						
Dinarites																						×
dalmatinus	×		×																			×
carniolicus	×																					×
liatsikasi			×																			×
undatus				×																		×
Hololobus																						×
monoptychus	×																					×
Pseudodinarites																						×
mohamedanus	×																					×
Hellenitidae																						
Hellenites																						e
praematurus		×	×							×												×
radiatus			×							×									×			×
Beyrichitidae																						
Beyrichites																						1
laurae			×																			×
Gymnitidae																						
Eogymnites																						×
arthaberi		×																				×
Hungaritidae																						
Prohungarites						×																×
crasseplicatus								×														×
tuberculatus								×														×
middlemissii							×															×
carinatus				×																		×
mckelvei																					×	×
gutstadti																					×	×
Dalmatites																						e
morlaccus	×																					×
Ussuritidae																						
Eophyllites																						×
dieneri		×	×																			×
orientalis								×														×
amurensis												×										×
Palaeophyllites																						
steinmanni			×					×														×
Ussurites																						1
sieveri																			×			×
hoesi																						×
Leiophyllites					×														×			1
variabilis		×	×									×										×
radians				×																		×
serpentinus										×												×
admaris												×										×
maritimus												×										×

TABLE 8. GEOGRAPHIC DISTRIBUTION OF AMMONOID GENERA OF *PROHUNGARITES* ZONE IN TERMS OF NUMBERS OF LOCALITIES OR REGIONS IN WHICH EACH GENUS IS PRESENT.

Number of Localities	Number of Genera	Percentage of Total Fauna
1	24	36.9
2	10	15.3
3	6	9.2
4	8	12.3
5	7	10.7
6	5	7.7
7	2	3.1
8	0	0
9	1	1.6
10	1	1.6
11	1	1.6

Within the Tethyan region the highest degree of endemism is found in the fauna of the Werfen Formation, with 6 genera out of a total of 11 restricted to that formation. A seventh genus, *Dalmatites*, is in the *Prohungarites* Zone, restricted to the Werfen Formation, but another species of this genus occurs in the underlying *Columbites* Zone in southeast Idaho. *Diaplococeras* is represented by two species, but the other endemic genera by only a single species each. Two of the species are known from only a single specimen each and the others from very few specimens.

The *Subcolumbites* fauna of Albania includes four endemic genera—*Protropites, Arianites, Beatites,* and *Eogymnites; Protropites* is a fairly common member of that fauna but the other three genera are known only from a single specimen each. The *Subcolumbites* fauna of Chios also contains four endemic genera—*Chiotites, Chioceras, Meropella,* and *Beyrichites.* Among these four genera, *Chiotites* is abundantly represented in the Chios fauna, but the other three genera are known from only three or four specimens each. In the Mangyshlak Peninsula the late Scythian fauna includes three endemic genera—*Procolumbites, Eukashmirites,* and *Doricranites*; of these, *Doricranites* appears to be by far the most common form. In the Salt Range the *Prohungarites* Zone contains fragmentary specimens of *Anakashmirites*, a genus not recorded from any other locality in this zone.

Within the western Pacific realm there are two endemic genera—*Paradinarites* and *Parussuria*—from the *Subcolumbites* faunas of Kwangsi, China. In the eastern Pacific realm there are only two endemic genera in the *Prohungarites* Zone faunas. *Monocanthites* is known only from late Scythian strata in British Columbia, and *Ussurites* only from Nevada and Utah. *Ussurites* is a fairly common Anisian genus, but the species recorded here are the first from the late Scythian. In the Arctic realm there are two endemic genera, *Boreomeekoceras* and *Arctotirolites*, both known from the Olenek fauna.

In evaluating the degree of similarity of these late Scythian faunas of the *Prohungarites* Zone, Simpson's index of faunal resemblance is useful (Simpson, 1943, 1947, 1953). This index is symbolized as 100 C/N, in which C stands for the number of taxonomic units common to two faunas, and N is the total number of genera in the smaller of the two. The number of genera in common and the index of correlations, on the basis of genera of these faunas attributed to the *Prohungarites* Zone, are given in Tables 9 and 10.

It is recognized that the composition of any of these faunas is influenced by factors of preservation, collection techniques, and facies. Evaluation of the relative significance of these factors in regard to each of the faunas is most difficult. The *Subcolumbites* faunas of Albania and Chios appear to have been thoroughly collected. This applies also to the fauna of the Werfen Formation; however, in this case more stratigraphic data are desirable. It is my impression from the literature that the Mangyshlak fauna contains more genera and species than those described to date. The Afghanistan and Salt Range faunas are known from small collections, mainly of poorly preserved specimens. The chance

TABLE 9. SUMMARY CHART OF NUMBERS OF GENERA IN COMMON BETWEEN FAUNAS OF THE *PROHUNGARITES* ZONE FROM NINETEEN LOCALITIES OR REGIONS.

	Werfen Fm.	Albania	Chios	Mangyshlak	Afghanistan	Salt & Surghar Ranges	Kashmir	Timor	New Zealand	Kwangsi, China	Japan	Primorye Region	Olenek	Spitsbergen	Ellesmere Island	British Columbia	Tobin Range	Confusion Range	Southeast Idaho
Werfen Fm.	11	1	1	3	0	2	0	0	0	0	0	0	1	0	0	0	1	1	1
Albania	1	28	19	7	8	6	0	10	1	13	1	11	4	0	0	6	8	2	3
Chios	1	19	27	7	7	3	0	9	0	10	1	9	4	0	1	5	8	1	3
Mangyshlak	3	7	7	15	4	5	1	4	0	3	0	4	3	0	1	1	4	3	4
Afghanistan	0	8	7	4	11	5	0	5	0	5	1	6	3	1	1	3	4	1	3
Salt & Surghar Ranges	2	6	3	5	5	13	11	5	0	5	0	4	5	2	1	3	3	2	4
Kashmir	0	0	0	1	0	1	1	1	0	0	0	0	0	0	0	0	0	0	1
Timor	0	10	9	4	5	5	1	12	0	4	0	4	2	0	0	2	3	1	2
New Zealand	0	1	0	0	0	0	0	0	1	1	0	1	1	0	0	1	0	0	0
Kwangsi, China	0	13	10	3	5	5	0	4	1	16	1	8	4	0	0	4	6	0	2
Japan	0	1	1	0	1	0	0	0	0	1	1	1	0	0	0	0	1	0	0
Primorye Region	0	11	9	4	6	4	0	4	1	8	1	11	3	0	0	3	5	1	2
Olenek	1	4	4	3	3	5	0	2	1	4	0	3	15	2	2	4	1	2	5
Spitsbergen	0	0	0	0	1	2	0	0	0	0	0	0	2	2	2	2	0	0	2
Ellesmere Island	0	0	1	1	1	1	0	0	0	0	0	0	2	2	4	3	0	0	2
British Columbia	0	6	5	1	3	3	0	2	1	4	0	3	4	2	3	11	2	0	3
Tobin Range	1	8	8	4	4	3	0	3	0	6	1	5	1	0	0	2	10	2	3
Confusion Range	1	2	1	3	1	2	0	1	0	0	0	1	2	0	0	0	2	4	1
Southeast Idaho	1	3	3	4	3	4	1	2	0	2	0	2	5	2	2	3	3	1	9
Total Genera	11	28	27	15	11	13	1	12	1	16	1	11	15	2	4	11	10	4	9

of ever uncovering larger and better preserved faunas from these localities is not good. The Timor fauna is known from isolated blocks mainly from a single locality. It is apparent that Welter's (1922) monograph has by no means dealt exhaustively with this fauna. New collecting on Timor is badly needed. The *Prohungarites* Zone faunas of New Zealand and Japan consist of a single species each. In these two areas facies and preservations have been the most severe limiting factors. The *Subcolumbites* fauna of Kwangsi, China, appears to have been adequately collected. The faunas of the Primorye Region and northern Siberia have been collected extensively but there is urgent need of more detailed stratigraphic and geographic data. I have the impression from the literature that ammonites are not abundant in these regions. Neither are ammonites of the *Prohungarites* Zone abundant in Ellesmere Island or in British Columbia. In these two areas logistical difficulties further complicate the problem and offer perhaps an explanation for the small size of the known faunas. The fauna of the Tobin Formation has been well collected, but I am sure that more search will yield additional specimens. The same applies to the fauna from Hammond Creek in southeast Idaho.

Considering all these factors, one should use some restraint in evaluating the faunal indices of Table 10; this of course applies more to the smaller faunas. If one assumes that contiguous faunas within a geologic

TABLE 10. INDEX OF FAUNAL SIMILARITY AT A GENERIC LEVEL FOR NINETEEN AMMONOID FAUNAS OF THE *PROHUNGARITES* ZONE.

	Werfen Fm.	Albania	Chios	Mangyshlak	Afghanistan	Salt & Surghar Ranges	Kashmir	Timor	New Zealand	Kwangsi, China	Japan	Primorye Region	Olenek	Spitsbergen	Ellesmere Island	British Columbia	Tobin Range	Confusion Range	Southeast Idaho
Werfen Fm.	100	9	9	27	0	18	0	0	0	0	0	0	9	0	0	0	11	25	11
Albania	9	100	70	46	72	46	0	83	100	81	100	100	26	0	0	54	80	50	33
Chios	9	70	100	46	63	23	0	75	0	62	100	81	26	0	25	45	80	25	33
Mangyshlak	27	46	46	100	36	38	100	33	0	20	0	36	20	0	25	9	40	75	44
Afghanistan	0	72	63	36	100	45	0	45	0	45	100	54	27	50	25	27	40	25	33
Salt & Surghar Ranges	18	46	23	38	45	100	100	41	0	38	0	36	38	100	25	27	30	50	44
Kashmir	0	0	0	100	0	100	100	100	0	0	0	0	0	0	0	0	0	0	100
Timor	0	83	75	33	45	41	100	100	0	33	0	36	16	0	0	18	30	25	22
New Zealand	0	100	0	0	0	0	0	0	100	100	0	100	100	0	0	100	0	0	0
Kwangsi, China	0	81	62	20	45	38	0	33	100	100	100	72	26	0	0	26	60	0	22
Japan	0	100	100	0	100	0	0	0	0	100	100	100	0	0	0	0	100	0	0
Primorye Region	0	100	81	36	54	36	0	36	100	72	100	100	27	0	0	27	50	25	22
Olenek	9	26	26	20	27	38	0	16	100	26	0	27	100	100	50	36	10	50	55
Spitsbergen	0	0	0	0	50	100	0	0	0	0	0	0	100	100	100	100	0	0	100
Ellesmere Island	0	0	25	25	25	25	0	0	0	0	0	0	50	100	100	75	0	0	50
British Columbia	0	54	45	9	27	27	0	18	100	26	0	27	36	100	75	100	20	0	33
Tobin Range	11	80	80	40	40	30	0	30	0	60	100	50	10	0	0	20	100	50	33
Confusion Range	25	50	25	75	25	50	0	25	0	0	0	25	50	0	0	0	50	100	25
Southeast Idaho	11	33	33	44	33	44	100	22	0	22	0	22	55	100	50	33	33	25	100
Total Genera	11	28	27	15	11	13	1	12	1	16	1	11	15	2	4	11	10	4	9

province reflect better the actual composition of the fauna, a computation of faunal resemblance between geologic provinces could be more meaningful. Scythian paleogeography is characterized by Tethys and by marginal geosynclines on the continents surrounding the Pacific and Arctic oceans. The Spitsbergen, Ellesmere Island, and northern Siberian (Olenek) faunas thus fall within an Arctic province. The eastern Pacific province includes the faunas from British Columbia, Nevada, Utah, and southeast Idaho. The western Pacific province includes the faunas from the Primorye Region, China, Japan, Timor, and New Zealand. The Tethyan province includes the Kashmir, West Pakistan, Afghanistan, Mangyshlak, Chios, Albania, and Werfen Formation faunas. The index of correlation of the faunas between these geologic provinces is given in Table 11. The Tethyan province has the largest fauna in total numbers of genera, and the largest number of genera are endemic to that province. In contrast, the Arctic province has the smallest total number of genera, while the eastern and western Pacific provinces are intermediate and have the same number of genera. There is a high degree of correlation of the western and eastern faunas with those of Tethys; the Arctic faunas show a lesser degree of correlation. It is of interest to note the relatively low degree of correlation between the Arctic province and the western Pacific; the correlation between the Arctic and the eastern Pacific provinces

TABLE 11. INDEX OF FAUNAL SIMILARITY AT A GENERIC LEVEL FOR AMMONOID FAUNAS OF THE *PROHUNGARITES* ZONE BETWEEN THE MAJOR PALEOGEOGRAPHIC PROVINCES.

	Tethys	W. Pacific	E. Pacific	Arctic
Tethys	100.0	92.0	84.0	68.7
W. Pacific	92.0	100.00	48.0	31.2
E. Pacific	84.0	48.0	100.00	56.3
Arctic	68.7	31.2	56.3	100.0
Total genera	57	25	25	16
Number of endemic genera	24	2	2	2
Percentage of endemic genera	42.1	8.0	8.0	12.5

TABLE 12. GEOGRAPHIC DISTRIBUTION OF AMMONOID SPECIES OF *PROHUNGARITES* ZONE IN TERMS OF NUMBER OF LOCALITIES OR REGIONS IN WHICH A SPECIES IS PRESENT.

Number of Localities	Number of Species	Percentage of Total Fauna
1	117	75.9
2	23	14.9
3	8	5.2
4	2	1.3
5	2	1.3
7	1	0.6
10	1	0.6

(56 percent) is approximately twice as good. At the same time the correlation between the eastern and western Pacific provinces is only 48 percent.

Only two of the 65 genera of the *Prohungarites* Zone, *Pseudosageceras* and *Prosphingites*, are present in all four of the main geologic provinces. There are, however, ten additional genera which occur in the Tethyan, western Pacific, and eastern Pacific provinces:

Cordillerites
Hemilecanites
Procarnites
Arnautoceltites
Isculitoides
Subcolumbites
Metadagnoceras
Hellenites
Prohungarites
Leiophyllites

Of this list of 10 genera, 7 are confined to the *Prohungarites* Zone, 2 are known from older horizons, and one is known from younger horizons.

Discounting for the moment the endemic genera within each province, the above widely distributed genera constitute 33 percent of the Tethyan fauna and 48 percent of the western and eastern Pacific faunas.

The faunas of the Arctic regions are more distinctive than the index of faunal similarities tends to suggest. The Arctic province includes 16 genera, of which only two (*Boreomeekoceras* and *Arctotirolites*) are endemic. Whereas all but two of the genera in the Arctic province are present in one or more of the other three major geologic provinces, there are significant differences in the relative representation of genera within this and the other provinces. The most characteristic and abundant genera in the Arctic fauna are *Svalbardiceras*, *Sibirites*, *Keyserlingites*, and *Olenekites*. Each of these genera is represented outside of the Arctic province by few species and specimens. *Svalbardiceras* is also known from a few fragmentary specimens in the Salt Range and in southeast Idaho. *Sibirites* is also known from only a few small specimens in the *Subcolumbites* fauna of Chios. Outside the Arctic region, *Keyserlingites* is known in the Tobin Formation of Nevada, the Thaynes Formation of southeast Idaho, and at Kotal-e-Tera, Afghanistan. Finally, *Olenekites* is known from only a few specimens in southeast Idaho and on the Mangyshlak Peninsula. In contrast to the sparse representation of these genera, in terms of numbers of localities represented and numbers of specimens outside of the Arctic province, they are widespread and common elements of the Arctic fauna.

Zenoites was first recognized in the *Subcolumbites* fauna of Chios and is now known also from Ellesmere Island. Likewise, *Proptychitoides* is a very common Tethyan form, now known to be represented by one specimen in northern Siberia. In contrast, *Prosphingites* is quite common in the eastern and western Pacific realms but is relatively rare or uncommon in Tethys and the Arctic province.

An analysis of the *Prohungarites* Zone

TABLE 13. SUMMARY CHART OF NUMBERS OF SPECIES IN COMMON BETWEEN THE FAUNAS OF THE *PROHUNGARITES* ZONE FROM NINETEEN LOCALITIES OR REGIONS.

	Werfen Fm.	Albania	Chios	Mangyshlak	Afghanistan	Salt & Surghar Ranges	Kashmir	Timor	New Zealand	Kwangsi, China	Japan	Primorye Region	Olenek	Spitsbergen	Ellesmere Island	British Columbia	Tobin Range	Confusion Range	Southeast Idaho
Werfen Fm.	15	1	1	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Albania	1	34	24	3	4	2	0	6	0	5	1	2	1	0	0	1	1	1	2
Chios	1	24	40	3	4	2	0	6	0	7	1	2	1	0	0	1	2	1	2
Mangyshlak	2	3	3	19	3	2	0	3	0	1	0	1	1	0	0	0	1	1	0
Afghanistan	0	4	4	3	4	2	0	3	0	2	1	1	1	0	0	0	1	1	0
Salt & Surghar Ranges	0	2	2	2	2	4	0	2	0	1	0	1	1	0	0	0	1	1	0
Kashmir	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0
Timor	0	6	6	3	3	2	0	13	0	2	0	1	1	0	0	0	1	1	0
New Zealand	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0
Kwangsi, China	0	5	7	1	2	1	0	2	0	22	1	0	0	0	0	1	1	0	0
Japan	0	1	1	0	1	0	0	0	0	1	1	0	0	0	0	0	0	0	0
Primorye Region	0	2	2	1	1	1	0	1	0	0	0	14	1	0	0	1	1	1	0
Olenek	0	1	1	1	1	1	0	1	0	0	0	1	18	2	1	2	1	1	0
Spitsbergen	0	0	0	0	0	0	0	0	0	0	0	0	2	3	1	1	0	0	0
Ellesmere Island	0	0	0	0	0	0	0	0	0	0	0	0	1	1	4	1	0	0	0
British Columbia	0	1	1	0	0	0	0	0	0	1	0	1	2	1	1	11	0	0	0
Tobin Range	0	1	2	1	1	1	0	1	0	1	0	1	1	0	0	0	9	1	0
Confusion Range	0	1	1	1	1	1	0	1	0	0	0	1	1	0	0	0	1	3	0
Southeast Idaho	0	2	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	7
Total Species	15	34	40	19	4	4	1	13	1	22	1	14	18	3	4	11	9	3	7

fauna at the generic level shows considerable similarity within and between the major geologic provinces. At the species level, as one would expect, there is a greater degree of endemism, that is, species known from a single region. Table 12 summarizes the geographic distribution of the species known from the *Prohungarites* Zone. It is impressive to note that approximately 75 percent of the species are known from only a single locality or region and only about 8 percent are known from 3 to 8 localities. The numbers of species in common between the various localities and regions are tabulated in Table 13, and the index of correlation (percent) in Table 14. In general there are very low or zero indices of correlation. It is impressive, however, to see the very high correlation between the *Subcolumbites* faunas of Albania and Chios; lesser but still significantly high correlations exist between the Albanian and Chios faunas and those of Timor and China. The main aspect of the chart is that there is a higher degree of correlation between localities within a geologic province than there is between different provinces.

In collecting from most ammonitiferous deposits it is a common experience that a few genera and species are overwhelmingly predominant, a few species are represented by modest numbers, and a group of species is represented by only one or two specimens each, even after extensive collecting. Even though there are multiple factors which

TABLE 14. INDEX OF FAUNAL SIMILARITY AT THE SPECIES LEVEL FOR NINETEEN AMMONOID FAUNAS OF THE *PROHUNGARITES* ZONE.

	Werfen Fm.	Albania	Chios	Mangyshlak	Afghanistan	Salt & Surghar Ranges	Kashmir	Timor	New Zealand	Kwangsi, China	Japan	Primorye Region	Olenek	Spitsbergen	Ellesmere Island	British Columbia	Tobin Range	Confusion Range	Southeast Idaho
Werfen Fm.	100	6	6	13	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Albania	6	100	70	15	100	50	0	46	0	22	100	14	5	0	0	9	11	33	28
Chios	6	70	100	15	100	50	0	46	0	31	100	14	5	0	0	9	22	33	28
Mangyshlak	13	15	15	100	75	50	0	23	0	5	0	7	5	0	0	0	11	33	0
Afghanistan	0	100	100	75	100	50	0	25	0	50	100	25	25	0	0	0	25	25	0
Salt & Surghar Ranges	0	50	50	50	50	100	0	50	0	25	0	25	25	0	0	0	25	33	0
Kashmir	0	0	0	0	0	0	100	0	0	0	0	0	0	0	0	0	0	0	0
Timor	0	46	46	23	75	50	0	100	0	15	0	7	7	0	0	0	11	33	0
New Zealand		0	0	0	0	0	0	0	100	0	0	0	0	0	0	0	0	0	0
Kwangsi, China	0	22	31	5	50	25	0	15	0	100	100	0	0	0	0	9	11	0	0
Japan	0	100	100	0	100	0	0	0	0	100	100	0	0	0	0	0	0	0	0
Primorye Region	0	14	14	7	25	25	0	7	0	0	0	100	7	0	0	9	11	33	0
Olenek	0	5	5	5	25	25	0	7	0	0	0	7	100	66	25	18	11	33	0
Spitsbergen	0	0	0	0	0	0	0	0	0	0	0	0	66	100	33	33	0	0	0
Ellesmere Island	0	0	0	0	0	0	0	0	0	0	0	0	25	33	100	25	0	0	0
British Columbia	0	9	9	0	0	0	0	0	0	9	0	9	18	33	25	100	0	0	0
Tobin Range	0	11	22	11	25	25	0	11	0	11	0	11	11	0	0	0	100	33	0
Confusion Range	0	33	33	33	25	33	0	33	0	0	0	33	33	0	0	0	33	100	0
Southeast Idaho	0	28	28	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	100
Total Species	15	34	40	19	4	4	1	13	1	22	1	14	18	3	4	11	9	3	7

can and do influence preservation, I believe it reasonable to assume that the number of specimens of a species represented in a well collected fauna does reflect the relative abundance of the species. If one accepts this assumption, it makes possible a further evaluation of the composition of the various faunas of the *Prohungarites* Zone and changes of abundance within the various populations.

Data on the total number of specimens and number of specimens per species for nine faunas are given on Table 3. The collections from the *Subcolumbites* faunas of Albania and Chios are by far the largest. The five commonest species in the *Subcolumbites* fauna of Albania in order of abundance are:

Subcolumbites perrinismithi
Procarnites kokeni
Isculitoides originis
Protropites hilmi
Prenkites malsorensis

The 9 species in the Chios fauna that are represented by 50 or more specimens in order of abundance are:

Isculitoides originis
Procarnites kokeni
Leiophyllites variabilis
Chioceras mitzopouloi
Albanites triadicus
Eophyllites dieneri
Hellenites praematurus
Pseudosageceras albanicum
Subcolumbites perrinismithi

Three of these species (*Isculitoides originis, Procarnites kokeni, Subcolumbites perrinismithi*) are predominant members in both faunas. *Protropites hilmi* is endemic to Albania, as is *Chioceras mitzopouloi* to the Chios fauna. Whereas *Prenkites malsorensis* is predominant in the Albanian fauna, it is represented by only two specimens in the Chios collection; *Hellenites praematurus* is very common in Chios but represented by only two specimens in the Albanian collection. Even though *Leiophyllites variabilis* is not on the list from Albania, it still is quite abundant, with 43 specimens in the collection; the same applies to *Eophyllites dieneri* with 40 specimens.

Subcolumbites is predominant in the Albania, Chios, Primorye, and Tobin Formation faunas. In Albania and Chios the species is *perrinismithi*, in the Primorye Region *multiformis*, and in the Tobin Formation *americanus*. *Subcolumbites* is also known from the Afghanistan and Kwangsi faunas, though in both collections by very few specimens only.

Hellenites is a predominant element only in the Chios fauna; in the Albanian, Kwangsi, and Nevada faunas it is represented by very few specimens. *Procarnites kokeni* occupies a position of predominance in the Albanian, Chios, and Kwangsi faunas. It is known from very few specimens in the Afghanistan, Salt Range, and Timor faunas.

Isculitoides is a predominant element in the Albanian, Chios, and southeast Idaho faunas but has only minor representation in the faunas of Afghanistan, Salt Range, China, Primorye, Nevada, and British Columbia.

Olenekites is a predominant element in the faunas of northern Siberia and Ellesmere Island, modestly represented in the Tobin Formation of Nevada (S.W. Muller, personal communication), and very minor in the faunas of the Mangyshlak Peninsula and southeast Idaho. *Prohungarites* is overwhelmingly the predominant element of the fauna from the Upper Thaynes Formation of southeast Idaho but is apparently only a minor element of the faunas of Timor, Kashmir, and the Mangyshlak Peninsula.

TABLE 15. NUMBER OF SPECIES PER GENUS AMONG GENERA OF AMMONOIDS IN THE *PROHUNGARITES* ZONE.

Number of Species per Genus	Number of Genera	Percentage of Total Genera
1	29	44.6
2	13	20.0
3	8	12.3
4	5	7.7
5	5	7.7
6	4	6.1
7	1	1.5

A look at the 11 genera which are represented in the Tethyan, western Pacific and eastern Pacific provinces yields some interesting data. Four of these genera (*Cordillerites, Hemilecanites, Prosphingites*, and *Metadagnoceras*) are not a common element in any of the faunas from which they are recorded. *Procarnites* and *Hellenites* are very common in one or more localities within Tethys but nowhere else. *Subcolumbites, Isculitoides*, and *Arnautoceltites* are predominant elements in one or more faunas in the Tethyan, western Pacific and eastern Pacific provinces. *Prohungarites* is common only in the eastern Pacific and *Leiophyllites* in the western Pacific.

Most genera from the *Prohungarites* Zone, that is, approximately 45 percent, are known from only a single species (Table 15). This for the most part reflects the high number of monotypic genera for this zone. At the same time some genera, for example *Cordillerites*, are widely distributed in three of the major paleogeographic provinces, though represented by a single species only. Only 15 genera, or 23 percent of the total fauna, are represented by four or more species. Eight of these genera with four or more species are among those which are known from at least three of the major paleogeographic provinces. Most of the other genera of this group are conspicuous elements of the faunas of one or two of the major paleogeographic provinces.

PALEOGEOGRAPHIC IMPLICATIONS OF *PROHUNGARITES* ZONE AMMONOIDS

Interest in paleoclimates has greatly heightened since the introduction of paleomagnetic techniques. In the excellent review on paleomagnetism by Cox and Doell (1960), it was encouraging to read in their summary a statement of the need for more and better paleontological data as a test of the geophysical conclusions now being advocated by many researchers. In the past decade there has been a definite increase in paleontological contributions to the problem of paleoclimates. The question rests on the assumption that temperature is the most significant of the factors that controls the distribution of many organisms. Clear-cut temperature gradients are recognized in the distribution patterns of many modern faunas and floras. The general problem of temperature gradients has been given an excellent review by A. G. Fischer (1960). The most active student of paleontology who has been applying the techniques of faunal gradients to the problem of paleoclimates has been F. G. Stehli. Ample testimony to the complexity of the problem can be seen in the number of enthusiastic rebuttals to many of the interpretations of Stehli and others. Craig (1961) has amply reviewed the techniques and limitations in using fossils for paleoclimatic interpretations. He concludes that (a) "we have insufficient knowledge of, and therefore control over, the variables that can affect the form and distribution of fossils," and (b) "stratigraphic correlation is not yet sufficiently accurate to be certain that we are interpreting paleoclimates of the same geological age" (Craig, 1961:224). Craig emphasizes that these somewhat "pessimistic conclusions" are meant to "sound a cautionary note."

Interpretation of the significance of the geographic distribution of the ammonoids of the *Prohungarites* Zone is handicapped by the sparseness of data from the Southern Hemisphere. There are no late Scythian marine deposits nor faunas as yet identified from Central and South America. The same applies to all of Africa, Madagascar, Australia, and Antarctica. As stated several times above, the basic paleogeographic pattern of the Scythian is that of Tethys, with circum-Atlantic and circum-Arctic marginal seas. There are no marine late Scythian deposits in the Atlantic basin south of Spitsbergen. This pattern of distribution of the known data precludes any direct comment on the problem of large scale horizontal displacements of continents. It is, however, worthwhile to consider the spatial distribution of the ammonoids of the *Prohungarites* Zone. We are first of all dealing with faunas considered to be part of a single zone that probably had a time duration of one to two million years. Working on a world scale I do not believe we shall be able to resolve our correlations much finer than this. The fact that the Tethyan region has the largest numbers of genera and species, the circum-Arctic region only approximately 30 percent as many, and the western and eastern Pacific areas an intermediate amount could very well reflect a climatic pattern. In addition, carbonate rocks are common in the Tethyan and circum-Pacific regions but are essentially absent in the circum-Arctic region for this segment of time. If one accepts the assumption that the known record to date is a reasonably valid reflection of the extent and diversity of late Scythian faunas, I find it most plausible to see here a true faunal gradient which most probably reflects climate. The data interpreted in this vein are more plausible when compared to the pattern of world continents that exists today than to any of the many and varied alternative maps which have been drawn.

SUMMARY OF *COLUMBITES* ZONE AMMONOIDS

The *Columbites* Zone is now known from four localities, southeast Idaho, Arctic Canada, Primorye Region, and northern Siberia. A summary list of the species and genera of this zone is tabulated in Table 16.

TABLE 16. SUMMARY TABLE OF GENERA AND SPECIES OF AMMONITES AND THEIR GEOGRAPHIC DISTRIBUTION IN THE *COLUMBITES* ZONE. SYMBOLS USED IN RIGHT HAND COLUMN (RANGE OF GENERA AND SPECIES) ARE AS FOLLOWS: × = PRESENT ONLY AT THIS HORIZON, — = PRESENT IN BOTH YOUNGER AND OLDER HORIZONS, e = PRESENT ALSO IN EARLIER HORIZONS, l = PRESENT ALSO IN LATER HORIZONS.

	Columbites Fauna Southeast Idaho	*Dieneroceras* Zone Northern Siberia	*Neocolumbites* Subzone Primorye Region	Range of Genera and Species
Sageceratidae				
Pseudosageceras				—
multilobatum	×	×		—
Cordillerites				—
angulatus	×			—
Dieneroceratidae				
Dieneroceras				—
demokidovi		×		×
apostolicus	×	×		×
Subvishnuites				—
eiekitensis		×		×
Xenoceltitidae				
Xenoceltites				—
spencei	×			×
Preflorianites				—
montpelierensis	×			×
Paranoritidae				
Pseudaspidites				e
popovi	×			×
posterius		×		×
Paranannitidae				
Columbites				×
parisianus	×		×	×
Procolumbites			×	l
Neocolumbites			×	×
Pseudoceltites				e
cheneyi	×			×
Meekoceratidae				
Svalbardiceras			×	l
sheldoni	×			×
Metadagnoceras				l
unicum			×	×
Nordophiceras				l
euomphalus		×		×
alexeevae		×		×
jacksoni	×			×
pilatum	×			×
Prionitidae				
Hemiprionites				e
costatus		×		×
Sibiritidae				
Keyserlingites			×	l
stephensoni	×			×
Olenekites			×	l
Tirolitidae				
Tirolites				—
harti	×			×
smithi	×			×
astakhovi	×			×
Hellenitidae				
Hellenites			×	l
idahoense	×			×
inopinatus			×	×
Hungaritidae				
Dalmatites				—
kittli	×			×
Ussuriidae				
Ussurites				l
mansfieldi	×			×

The limited areas from which this fauna is known do not allow the broad synthesis that was possible for the ammonoids of the *Prohungarites* Zone. Most of the pertinent data regarding the ammonoids of this zone and their relationship to the underlying faunas of the *Owenites* Zone and the overlying faunas of the *Prohungarites* Zone have already been discussed in the section on chronology. The relationships of the ammonoid fauna of the *Columbites* Zone to those of the underlying *Owenites* Zone and the overlying *Prohungarites* Zone are summarized at a generic level on Table 17.

STRATIGRAPHY AND FAUNAS OF THE LATE SCYTHIAN

Ammonoid faunas of late Scythian age are now known from 17 localities or regions (Fig. 1). In this chapter are summarized the stratigraphic and faunal data on each of these occurrences. The discussion first

TABLE 17. TOTAL GENERA AND THEIR RANGES IN THE THREE UPPER ZONES OF THE LATE SCYTHIAN. SYMBOLS USED IN THE FOUR RIGHT HAND COLUMNS ARE AS FOLLOWS: × = PRESENT ONLY AT THIS HORIZON, — = PRESENT IN BOTH YOUNGER AND OLDER HORIZONS, e = PRESENT ALSO IN EARLIER HORIZONS, l = PRESENT ALSO IN LATER HORIZONS.

	Total Genera	Tethys	W. Pacific	E. Pacific	Arctic	×	e	—	l
Prohungarites	65	57	25	25	16	42	20	1	2
Columbites	21		8	15	6	2	2	7	16
Owenites	58	34	43	32	14	38	6	1	13

centers on the Tethyan faunas proceeding from west to east; then the areas in the western Pacific belt are discussed; this leads to the circum-Arctic region, and finally to the east Pacific localities. For each locality that has previously been monographed the original faunal list is given plus a summary list of the species I recognize based on the discussion in the systematic portion of this report.

Albania

One of the most abundant and diverse of late Scythian faunas is that from Kčira, Albania. This fauna, originally collected by Dr. Franz Baron Nopcsa and studied by G. Arthaber (1908, 1909, 1911), occurs in a one meter bed of red nodular limestone. There are no other Scythian faunas known in the sequence of strata at Kčira. Arthaber recognized in this fauna 59 species, placed in 30 genera; a list of these species is as follows:

Pseudosageceras drinense Arthaber
Sageceras albanicum Arthaber
Pronorites triadicus Arthaber
Pronorites osmanicus Arthaber
Pronorites arbanus Arthaber
Hedenstroemia kastriotae Arthaber
Hedenstroemia skipetarensis Arthaber
Beatites berthae Arthaber
Procarnites kokeni Arthaber
Procarnites skanderbegis Arthaber
Paranannites mediterraneus Arthaber
Proptychites latifimbriatus de Koninck
Proptychites kraffti Arthaber
Proptychites trigonalis Arthaber
Proptychites bertisci Arthaber
Proptychites obliqueplicatus Waagen
Xenodiscus sulioticus Arthaber
Xenaspis mediterranea Arthaber
Japonites sugriva Diener
Monophyllites dieneri Arthaber
Monophyllites pitamaha Diener
Monophyllites kingi Diener
Monophyllites hara Diener
Monophyllites nopcsai Arthaber
Lecanites skutarensis Arthaber
Lecanites fishtae Arthaber
Lecanites niazi Arthaber
Lecanites discus Arthaber
Ophiceras sakuntala Diener
Ophiceras cfr. *nangaensis* Waagen
Dagnoceras nopcsanum Arthaber
Dagnoceras zappanense Arthaber
Dagnoceras terbunicum Arthaber
Dagnoceras komanum Arthaber
Dagnoceras lejanum Arthaber
Meekoceras radiosum Waagen
Meekoceras skodrense Arthaber
Meekoceras hakki Arthaber
Meekoceras mahomedis Arthaber
Aspidites hasserti Arthaber
Aspidites marginalis Arthaber
Tirolites illyricus Mojsisovics
Tirolites rectangularis Mojsisovics
Prosphingites ali Arthaber
Pseudosibirites cfr. *dichotomus* Waagen
Protropites hilmi Arthaber
Prenkites malsorensis Arthaber
Isculites originis Arthaber
Styrites lilangensis Diener
Columbites europaeus Arthaber
Columbites perrinismithi Arthaber
Columbites dusmani Arthaber
Columbites mirditensis Arthaber
Arianites musacchi Arthaber
Paragoceras dukagini Arthaber
Celtites arnauticus Arthaber
Celtites kcirensis Arthaber
Epiceltites gentii Arthaber
(?) *Tropiceltites praematurus* Arthaber

What specimens remain of the Kčira collection studied by Arthaber are deposited in the Paleontological Institute, University of Vienna. This collection now consists mainly of the illustrated specimens. The fate of the many unfigured paratypes is

Figure 1. Index map of localities where faunas of *Prohungarites* Zone age have been reported. (1) Upper Thaynes Formation, southeastern Idaho; (2) Upper Thaynes Formation, west-central Utah; (3) Tobin Formation, Tobin Range, Nevada; (4) *Subcolumbites* fauna, Providence Range, southeastern California; (5) Humboldt Range, Nevada; (6) Toad-Grayling Formation, northeastern British Columbia; (7) Upper Scythian of Ellesmere Island and Axel Heiberg Island; (8) Spitsbergen; (9) Olenek-Lena River Basin, Siberia; (10) Okhotsk-Kolyma Land, Siberia; (11) Primorye Region around Vladivostok; (12) Osawa Formation near Sendai, Japan; (13) south Otago, South Island, New Zealand; (14) *Prohungarites* fauna, Nifoekoko, Timor; (15) *Subcolumbites* fauna, Kwangsi, China; (16) *Prohungarites* fauna, Kashmir, Himalayas; (17) Narmia Member, Mianwali Formation, Salt Range and Surghar Range, West Pakistan; (18) *Subcolumbites* fauna, Kotal-e-Tera, Afghanistan; (19) Tyur-Upa Suite, Mangyshlak Peninsula, Caspian region; (20) *Subcolumbites* fauna of Chios; (21) *Subcolumbites* fauna of Albania; (22) *Tirolites* fauna of Campil Member of Werfen Formation.

unknown, though part or all of them may be in the collection obtained by the British Museum (Natural History) in 1922, by purchase. All of the existing specimens from Albania in these two institutions have been thoroughly studied and are discussed in the systematic part of this paper. Arthaber's illustrations of his species are highly retouched photographs and in many cases quite misleading. Likewise, many of his suture drawings were not as successful as one would like. Unretouched photographs of the primary types and new drawings of many sutures are presented in the systematic chapter.

My own studies of this fauna lead me to conclude that it consists of 32 species, placed in 27 genera. A summary list of the species recognized is given on Table 18. I was unable to evaluate four of Arthaber's species: *Lecanites fishtae, Lecanites niazi, Meekoceras skodrense, Aspidites marginalis.* I consider these as unrecognizable species, and thus they are not treated in the taxonomic summary of the fauna.

Chios

The largest and most diverse of any late Scythian ammonite fauna is that from the island of Chios collected by Dr. C. Renz and associates. The collection consists of nearly 2,000 specimens and is deposited in the Natural History Museum, Basel. The ammonites come from hard, red, siliceous limestone; there are no other Scythian faunas known from Chios. The fauna is almost identical to that from Kčira, Albania, which likewise occurs in a hard, red, siliceous limestone. Renz and Renz (1947, 1948) recognized 116 species, subspecies,

TABLE 18. SUMMARY LIST OF SPECIES RECOGNIZED IN THIS REPORT FROM THE *SUBCOLUMBITES* FAUNAS OF ALBANIA AND CHIOS.

	Albania	Chios		Albania	Chios
Pseudosageceras multilobatum Noetling		×	*Prenkites timorensis* Spath		×
Pseudosageceras drinense Arthaber	×	×	*Prenkites helenae* Renz and Renz		×
Pseudosageceras albanicum (Arthaber)	×	×	*Protropites hilmi* Arthaber	×	
Pseudosageceras pasquayi Renz and Renz		×	*Chioceras mitzopouloi* Renz and Renz		×
Cordillerites angulatus Hyatt and Smith	×	×	*Chioceras nodosum* Renz and Renz		×
Dieneroceras mediterranea (Arthaber)	×	×	*Arianites musacchi* Arthaber	×	
Dieneroceras skutarensis (Arthaber)	×	×	*Meropella plejanae* Renz and Renz		×
Subvishnuites enveris (Arthaber)	×		*Epiceltites genti* Arthaber	×	×
Hemilecanites discus (Arthaber)	×	×	*Metahedenstroemia kastriotae* (Arthaber)	×	×
Preflorianites sulioticus (Arthaber)	×	×	*Beatites berthae* Arthaber	×	
Preflorianites garbinus (Renz and Renz)		×	*Dagnoceras nopcsanum* Arthaber	×	
Proptychitoides decipiens Spath	×	×	*Dagnoceras zappanense* Arthaber	×	
Proptychitoides trigonalis (Arthaber)	×	×	*Metadagnoceras terbunicum* (Arthaber)	×	×
Procarnites kokeni (Arthaber)	×	×	*Albanites triadicus* (Arthaber)	×	×
Arnautoceltites mediterraneus (Arthaber)	×	×	*Sibirites renzi* n. sp.		×
Prosphingites ali Arthaber	×		*Tirolites idrianus* (Hauer)	×	
Zenoites helenae Renz and Renz		×	*Dinarites dalmatinus* (Hauer)		×
Zenoites vonderschmitti (Renz and Renz)		×	*Dinarites liatsikasi* Renz and Renz		×
Isculitoides originis (Arthaber)	×	×	*Hellenites praematurus* (Arthaber)	×	×
Chiotites globularis Renz and Renz		×	*Hellenites radiatus* Renz and Renz		×
Tunglanites alexi n. sp.	×	×	*Beyrichites laurae* Renz and Renz		×
Subcolumbites perrinismithi (Arthaber)	×	×	*Eogymnites arthaberi* (Diener)	×	
Subcolumbites dusmani (Arthaber)	×	×	*Eophyllites dieneri* (Arthaber)	×	×
Vickohlerites sundaicus (Welter)		×	*Palaeophyllites steinmanni* Welter		×
Prenkites malsorensis (Arthaber)	×	×	*Leiophyllites variabilis* Spath	×	×

and varieties placed in 38 genera and subgenera; a list of these taxa is as follows:

Columbites europaeus Arthaber
Columbites perrinismithi Arthaber
Columbites europaeusperrinismithi Renz and Renz
Columbites mirditensis Arthaber
Columbites dianae Renz and Renz
Columbites dianae var. Renz and Renz
Columbites parisianus Hyatt and Smith
Columbites spencei Smith var. *chiotica* Renz and Renz
Columbites ex aff. *plicatuli* Smith
Columbites malayanus C. Renz
Columbites malayanus var. C. Renz
Columbites malayanus C. Renz var. *crassa* Renz and Renz
Columbites bubulinae Renz and Renz
Columbites graecoamericanus Renz and Renz
Columbites levantinus Renz and Renz
Columbites aithaliae Renz and Renz
Columbites hellenicus Renz and Renz
Prenkites malsorensis Arthaber var. Renz and Renz
Prenkites sundaicus Welter
Prenkites helenae Renz and Renz
cf. *Styrites lilangensis* Diener
Iscultites originis Arthaber
Iscultites globulus Renz and Renz
Iscultites globulus var. Renz and Renz
Iscultites antiglobulus Renz and Renz
Iscultites antiglobulus var. Renz and Renz
Iscultites globulusoriginis Renz and Renz
Iscultites globulusantiglobulus Renz and Renz
Anasibirites aff. *anguloso* (Waagen)
Chioceras mitzopouloi Renz and Renz
Chioceras mitzopouloi var. *meridionalis* Renz and Renz
Chioceras nodosum Renz and Renz
Prosphingites ex aff. *czekanowskii* Mojsisovics
Prosphingites vonderschmitti Renz and Renz
Prosphingites (Chiotites) globularis Renz and Renz
Prosphingites (Chiotites) superglobosus Renz and Renz
Prosphingites (Zenoites) helenae Renz and Renz
Prosphingites (Zenoites) helenae var. *maradovunensis* Renz and Renz
Celtites kcirensis Arthaber
Epiceltites gentii Arthaber
Hellenites praematurus (Arthaber)
Hellenites praematurus var. *aegaeica* Renz and Renz
Hellenites trikkalinoi Renz and Renz

Hellenites trikkalinoi var. Renz and Renz
Hellenites trikkalinoi var. *graeca* Renz and Renz
Hellenites (*Pallasites*) *radiatus* Renz and Renz
Hellenites (*Pallasites*) *striatus* Renz and Renz
Hellenites (*Pallasites*) *striatus* var. *densicostata* Renz and Renz
Dinarites nudus Mojsisovics
Dinarites evolutior Kittl
Dinarites liatsikasi Renz and Renz
Stacheites dionysi Renz and Renz
Stacheites dionysi var. Renz and Renz
Dagnoceras terbunicum Arthaber
Dagnoceras nopcsanum var. *involuta* Renz and Renz
Meekoceras cf. *gracilitatis* White
Inyoites garbinus Renz and Renz
Ophiceras cf. *demissum* Oppel
Flemingites pseudorusselli Renz and Renz
Lecanites skutarensis Arthaber
Lecanites discus Arthaber
Xenodiscus sulioticus Arthaber
Koninckites bernoulii Renz and Renz
Koninckites bernoullii var. Renz and Renz
Koninckites timorensis Renz and Renz
Beyrichites praematurus Renz and Renz
Beyrichites laurae Renz and Renz
Proptychites mohamedis (Arthaber) var. *applanata* Renz and Renz
Proptychites ktenasi Renz and Renz
Proptychites arthaberi Welter
Proptychites balcanicus Renz and Renz
Proptychites mistardisi Renz and Renz
Proptychites lawrencianus (de Koninck) mut. *postindica* Renz and Renz
Proptychites buxtorfi Renz and Renz
cf. *Nannites hindostanus* Diener
cf. *Nannites medius* Krafft and Diener
Paranannites aspenensis Hyatt and Smith var. *europaea* Renz and Renz
Paranannites mediterraneus Arthaber
Paranannites mediterraneus var. *media* Renz and Renz
Paranannites chionensis Renz and Renz
Paranannites compressus Renz and Renz
Monophyllites (*Leiophyllites*) *praeconfucii* Renz and Renz
Monophyllites (*Leiophyllites*) *georgalasi* Renz and Renz
Monophyllites (*Leiophyllites*) *rosae* Renz and Renz
Monophyllites (*Leiophyllites*) *dieneri* Arthaber var. *involuta* Renz and Renz
Monophyllites (*Leiophyllites*) *palaeotriadicus* Renz and Renz
Monophyllites (*Leiophyllites*) aff. *pitamaha* Diener
Monophyllites (*Schizophyllites*) *betilloni* Renz and Renz
Monophyllites (*Schizophyllites*) *betilloni* var. *evoluta* Renz and Renz
Monophyllites (?*Schizophyllites*) *pseudohara* Renz and Renz
Monophyllites (*Palaeophyllites*) *thalmanni* Renz and Renz
Monophyllites (*Palaeophyllites*) *praekieperti* Renz and Renz
Procarnites kokeni Arthaber
Procarnites kokeni var. Renz and Renz
Procarnites kokeni var. *evoluta* Renz and Renz
Procarnites kokeni var. *panteleimonensis* Renz and Renz
Procarnites skanderbegis Arthaber
Hedenstroemia pityoussae Renz and Renz
Pronorites triadicus Arthaber var. Renz and Renz
Pronorites arbanus Arthaber
Pronorites arbanus Arthaber var. Renz and Renz
Pronorites arbanus Arthaber var. *mediterranea* Renz and Renz
Pronorites orientalis Renz and Renz
Pronorites cf. *osmanicus* Arthaber
Pronorites schaubi Renz and Renz
Pronorites schaubi var. *kephalovunensis* Renz and Renz
Pronorites reicheli Renz and Renz
cf. *Cordillerites angulatus* Hyatt and Smith
Pseudosageceras cf. *clavisellatum* Diener
Pseudosageceras intermontanum Hyatt and Smith
Pseudosageceras drinense Arthaber
Pseudosageceras drinense var. *incentrolata* Renz and Renz
Pseudosageceras (*Metasageceras*) *pasquayi* Renz and Renz
Sageceras albanicum Arthaber var. Renz and Renz
Arianites (*Meropella*) *plejanae* Renz and Renz
cf. *Paragoceras dukagini* Arthaber

My own study of the Renz collection in the Natural History Museum, Basel, leads me to conclude that the fauna consists of 41 species placed in 27 genera. A summary of my taxonomic conclusion is given on Table 18. The illustrations of this fauna in the Renz and Renz (1948) monograph are excellent and thus need not be reproduced here.

The *Subcolumbites* faunas of Chios and Albania contain a few specimens that are "normal" Anisian species. In the Chios fauna there is *Beyrichites laurae*, recognized on the basis of three specimens, and in the Albanian fauna there is *Eogymnites arthaberi*. The preservation in red limestone and the distribution of the fossils in lenticular "pockets," at least as far as the Chios fauna is concerned, does raise a question of possible mixing. Renz and Renz (1948:61)

recognized the unusual aspect of *Beyrichites* in their Chios fauna but came to the conclusion that the faunas were not mixed. The fact that *Beyrichites* is represented by only three specimens tends to support their thesis. On the basis of the data available I have elected to accept *Beyrichites* as a valid member of the late Scythian ammonoid faunas.

Werfen Formation

The ammonite fauna of the Werfen Formation of the Alps and associated regions, characterized by the great abundance of *Tirolites*, has been an enigma among Scythian faunas. It is a unique fauna quite unlike that of any other of the Scythian. This uniqueness is the cause of an array of conflicting opinions as to its age. A review of the conclusions on the age of this fauna by such pioneer students as Mojsisovics, Waagen, Diener, etc. cannot serve any useful purpose here. It was J. P. Smith (1932) who provided the basis for the prevalent current interpretation of the age relations of the *Tirolites* fauna. Within the Thaynes Formation cropping out in Paris Canyon, southeast Idaho, Smith encountered a poorly preserved fauna 225 feet above the *Meekoceras* fauna and 30 feet below his *Columbites* fauna. Within this fauna, Smith (1932:11) recognized four species of ammonites: *Dalmatites attenuatus, Tirolites harti, T. knighti*, and *T. peali*. On the age and correlation of this small fauna Smith (1932:10) concluded: "*Tirolites* constitutes the most abundant and characteristic element of the fauna, with species closely allied with those of the Campil beds of the Tyrol, giving a definite correlation and marking the first appearance of Mediterranean types in the American Lower Triassic." Smith thus recognized a *Tirolites* Zone stratigraphically between his *Meekoceras* Zone below and the *Columbites* Zone above. This scheme was also adopted by Spath (1934:27), and in the Treatise (Kummel *in* Arkell, et al., 1957). The age relations of the so-called *Tirolites* fauna thus hinged on the stratigraphic position of a small lot of poorly preserved ammonites from a single locality and horizon in southeastern Idaho. Needless to say, this was a most unsatisfactory situation.

The discovery and study of a number of new upper Scythian faunas in the past couple of decades has contributed many new faunal and stratigraphic data that warrant a new evaluation of the Werfen fauna. The most comprehensive previous analysis of the Werfen fauna was that by Kittl (1903) who recognized 59 species, listed below.

Dinarites laevis Tommasi
Dinarites muchianus (Hauer)
Dinarites evolutior Kittl
Dinarites biangulatus Kittl
Dinarites nudus Kittl
Dinarites dalmatinus (Hauer)
Dinarites multicostatus Kittl
Dinarites tirolitoides Kittl
Dinarites ?angulatus Kittl
Dinarites (*Hercegovites*) *mohamedanus* Mojsisovics
Dinarites (*Hercegovites*) *diocletiani* Kittl
Dinarites (*Liccaites*) *circumplicatus* Mojsisovics
Dinarites (*Liccaites*) *connectens* Mojsisovics
Dinarites (*Liccaites*) *liccanus* (Hauer)
Dinarites (*Liccaites*) *progressus* Kittl
Stacheites prionoides Kittl
Ceratites (*Paraceratites*) *prior* Kittl
Tirolites (*Hololobus*) *monoptychus* Kittl
Tirolites carniolicus Mojsisovics
Tirolites serratelobatus Kittl
Tirolites idrianus (Hauer)
Tirolites heterophanus Kittl
Tirolites mercurii Mojsisovics
Tirolites paucispinatus Kittl
Tirolites seminudus Mojsisovics
Tirolites distans Kittl
Tirolites quenstedti Mojsisovics
Tirolites robustus Kittl
Tirolites dimidiatus Kittl
Tirolites stachei Kittl
Tirolites dinarus Mojsisovics
Tirolites hybridus Kittl
Tirolites angustus Kittl
Tirolites subillyricus Kittl
Tirolites illyricus Mojsisovics
Tirolites repulsus Kittl
Tirolites rotiformis Kittl
Tirolites rectangularis Mojsisovics
Tirolites undulatus Kittl
Tirolites angustilobatus Kittl
Tirolites cassianus (Quenstedt)
Tirolites spinosus Mojsisovics

Tirolites haueri Mojsisovics
Tirolites multispinatus Kittl
Tirolites percostatus Kittl
Tirolites turgidus Mojsisovics
Tirolites darwini Mojsisovics
Tirolites spinosior Kittl
Tirolites smiriagini (Auerbach)
Tirolites kerneri Kittl
Tirolites toulai Kittl
Tirolites (*Svilajites*) *cingulatus* Kittl
Tirolites (*Svilajites*) *tietzei* Kittl
Tirolites (*Bittnerites*) *malici* Kittl
Tirolites (*Bittnerites*) *bittneri* Kittl
Tirolites (*Bittnerites*) ?*telleri* Kittl
Kymatites svilajanus Kittl
Meekoceras caprilense Mojsisovics
Dalmatites morlaccus Kittl

I have had the opportunity of examining the very large collections of Werfen ammonites that constituted the basis for Kittl's monograph. All of Kittl's taxa are treated in the systematic portion of this report. My own analysis of this fauna leads me to believe it consists of only 13 species included in 9 genera. A summary list of these species is as follows:

Dalmatites morlaccus Kittl
Stacheites prionoides Kittl
Dinarites dalmatinus (Hauer)
Dinarites carniolicus (Mojsisovics)
Diaplococeras liccanum (Hauer)
Diaplococeras connectens (Mojsisovics)
Pseudokymatites svilajanus (Kittl)
Pseudodinarites mohamedanus (Mojsisovics)
Bittnerites bittneri Kittl
Hololobus monoptychus (Kittl)
Tirolites idrianus (Hauer)
Tirolites cassianus (Quenstedt)
Tirolites cingulatus Kittl

The species of *Tirolites* completely dominate the fauna, being represented by several hundred specimens. *Dinarites* is also represented by many specimens but still considerably less than specimens of *Tirolites*. The other species are represented by very few specimens. *Stacheites prionoides*, *Pseudokymatites svilajanus* Kittl, and *Hololobus monoptychus* are represented only by a single specimen each. *Diaplococeras liccanum* is represented by 2 specimens, *Bittnerites bittneri* by 5 specimens, *Pseudodinarites mohamedanus* by 6 specimens, *Dalmatites morlaccus* by 10 specimens, and *Diaplococeras connectens* by 11 specimens. Species of *Tirolites* and *Dinarites* include approximately 95 percent of all the specimens in this collection.

Recently, Ganev (1966) has described a small fauna from the Campil beds of Bulgaria, recognizing the following species:

Lanceolites discoidalis Ganev
Balkanites tabulatus Ganev
Tirolites bispinatus Ganev
Dinarites muchianus (Hauer)
Dinarites progressus Kittl

Through the courtesy of Dr. Ganev, I have photographs and plaster casts of the specimens illustrated in his paper. This is the first record of *Lanceolites* outside of North America where the type species of the genus is a prominent member of the *Meekoceras* fauna. *Balkanites* is a new genus known only from Bulgaria. The specimens assigned to *Tirolites bispinatus* I believe to be *Tirolites cassianus*; those assigned to *Dinarites progressus* belong in *Diaplococeras connectens*; and those assigned to *Dinarites muchianus* belong in *Dinarites dalmatinus*. It appears from Ganev's (1966) paper that he had only 10 specimens in his fauna.

As stated above, the age assignment of the Werfen fauna arrived at by Smith rests almost entirely on the position of the *Tirolites* fauna in the Thaynes Formation exposed in Paris Canyon, southeast Idaho. An evaluation of all genera and species in the Werfen fauna suggests a quite different age assignment. The Werfen fauna includes only 11 genera of ammonoids, but 6 of these (*Diaplococeras*, *Hololobus*, *Bittnerites*, *Pseudodinarites*, *Balkanites*, and *Pseudokymatites*) are endemic to the Werfen Formation. The species of these endemic genera are represented by only 27 specimens. The morphological characteristics of these genera are not of any particular help in establishing an age for the fauna. *Dalmatites* is represented in the *Tirolites* fauna of southeast Idaho (*D. attenuatus*) and in the overlying *Columbites* fauna (*D. kittli* n. sp.). Smith (1932:81) described *Dalmatites richardsi* from the

Meekoceras fauna of southeast Idaho. These are the only species of this genus recorded to date. I agree with Spath (1951: 20) that *Dalmatites ropini* Diener (1907: 93, pl. 9, figs. 5, 6) of Anisian age is generically distinct from the Scythian species mentioned above. *Lanceolites* was previously known only from two species in the *Meekoceras* limestone of western United States. The genus *Stacheites* is now known from four additional localities. Astakhova (1960b) records *Stacheites prionoides* from the uppermost of her faunal horizons in the Scythian formations on the Mangyshlak Peninsula. In fact, she named her uppermost zone the *Stacheites* Zone but did not describe or illustrate her specimens. Kummel (1966) recorded a poorly preserved specimen as *Stacheites* sp. indet. from the uppermost fossiliferous horizon of the Scythian strata in the Surghar Range of West Pakistan in a rock unit also containing *Prohungarites* sp., *Procarnites kokeni*, *Dagnoceras* cf. *zappanense*. In the systematic portion of this report *Stacheites floweri* n. sp. is described from the Tobin Formation of Nevada where it is associated with *Subcolumbites*, *Hemilecanites*, *Isculitoides*, etc. An indeterminate species of *Stacheites* from the *Prohungarites* fauna of the upper Thaynes Formation of southeast Idaho is described in the systematic portion of this paper. These four additional records of *Stacheites* are clearly from horizons assignable to the late Scythian *Prohungarites* Zone.

Species of *Dinarites* are the second most abundant form represented in the Werfen fauna. Fortunately, species of this genus are now known from the *Subcolumbites* fauna of Chios and from the Scythian Formation of the Mangyshlak Peninsula. The Chios specimens that Renz and Renz (1948) assigned to *Dinarites nudus* Mojsisovics and *Dinarites evolutior* Kittl are here considered more properly assigned to *Dinarites dalmatinus*. A third dinaritid in the Chios fauna, *Dinarites liatsikasi* Renz and Renz, is unique because of its close similarity to *Dinarites undatus* Astakhova from the Mangyshlak Peninsula. *Dinarites undatus* is recorded from the *Tirolites* Zone of Astakhova, lying above beds containing *Procarnites kokeni* and *Prohungarites carinatus* and beneath horizons containing species of *Albanites*, *Olenekites*, *Epiceltites*, etc.

Finally, there is the genus *Tirolites*, the dominant element in the Werfen fauna and the genus Smith (1932) relied upon, almost entirely, in correlation of his *Tirolites* Zone. In concluding that *Tirolites* had a very narrow stratigraphic range, Smith (1932) ignored the species that Krafft and Diener (1909) described from the *Hedenstroemia* fauna of the Himalayas (*T. injucundus*), the specimens described by Arthaber (1911) from the *Subcolumbites* fauna of Albania, or his own record (Smith, 1932) of a species of *Tirolites* from his *Columbites* fauna. In addition, Popov (1961) has described tirolitids from late Scythian strata in northern Siberia, and Silberling (*in* Hose and Repenning, 1959) records tirolitids from a late Scythian horizon in western Utah. The genus *Tirolites* is the dominant element only in the Werfen Formation fauna; in all other recorded occurrences the genus is represented by relatively few specimens. The age span of the genus now clearly encompasses all of the upper half of the Scythian.

In summary, the Werfen Formation fauna contains 11 genera, 6 of which are endemic. One genus (*Dalmatites*) is known from the *Meekoceras* and *Columbites* faunas, another (*Lanceolites*) is known from the *Meekoceras* fauna. Two genera (*Stacheites* and *Dinarites*) are known from outside of the Mediterranean region by species from late Scythian faunas of *Prohungarites* Zone age. It thus appears to be unsound to rely on *Tirolites* to establish the age of the Werfen fauna; for this, much greater reliance can be put on *Stacheites* and *Dinarites*. This leads to the conclusion that the Werfen fauna is of late Scythian, *Prohungarites* Zone age.

Mangyshlak Peninsula

The presence of Scythian formations on the Mangyshlak Peninsula has been known for the better part of this century. In spite of several investigations of these strata there prevails considerable controversy over the stratigraphy and correlation of most of the units. M. V. Bajarunas (1936) was the first to present a stratigraphic sequence with a list of the ammonites present, which unfortunately included many *nomina nuda*. According to Bajarunas, the lowest 15 m of the Triassic section consist of limestones and marls which contain *Doricranites bogdoanus* v. Buch, *D. rossicus* Mojsisovics, *D. acutus* Mojsisovics, and *Subdoricranites discoides* (*nomina nuda* for both genus and species). It is of interest to note Bajarunas's comment that this fauna was characterized by numerous individuals but few species. Above this lower fossiliferous unit are 100 m of unfossiliferous siliceous shales. These are followed by 200 m of marly shales with seams of marly limestone and calcareous marly concretions, rich in ammonites. This series of strata is divisible into four units; the lowest part, of 23 m, contains *Ophiceras* cf. *demissum*, *Xenodiscus* sp., *Pseudosageceras multilobatum* Noetling, *Neotoceras mokrinskii* Bajarunas (both genus and species *nomina nuda*). The next 30 m are chiefly characterized by *Pseudosageceras multilobatum* Noetling, *Procolumbites karatauciki* Bajarunas (both genus and species *nomina nuda*), *Procarnites andrusovi* Bajarunas (*nomina nuda*), *Thermalites* n. sp. and other species. The third division, of 80 m, contains *Columbites* cf. *parisianus* Hyatt and Smith, *C. asiaticus* Bajarunas (*nomina nuda*), *C. dolnapensis* Bajarunas (*nomina nuda*), *C. adai* Bajarunas (*nomina nuda*), *C. ligatiformis* Bajarunas (*nomina nuda*), *C. tururpensis* Bajarunas (*nomina nuda*), *C. gracilis* Bajarunas (*nomina nuda*), *Tirolites* n. sp. and others (unnamed). The uppermost division, of 65 m, is characterized by several forms of *Tirolites* and *Dinarites*.

On the basis of this faunal sequence, Bajarunas (1936) came to the conclusion that since *Doricranites* lay below beds containing *Pseudosageceras* and *Ophiceras*, the *Doricranites* strata must be correlative with the *Otoceras* beds of the Himalayas, that is, at the base of the Scythian. However, the lack of any detailed discussion of these faunas or any illustrations, plus the large number of *nomina nuda*, are severe handicaps in formulating any judgment on the basis of Bajarunas' conclusions.

Kiparisova (1947) briefly discussed the Mangyshlak section and described some of the ammonites, making specific note of the fact that detailed stratigraphic data were lacking for much of the material available to her. However, she did describe from the upper unit (the 80 m unit below the uppermost division of 65 m with *Tirolites* and *Dinarites*) of Bajarunas' section *Columbites dolnapaensis* Kiparisova (= *C. dolnapaensis* Bajarunas MS), *Kashmirites subdimorphus* Kiparisova, *Anasibirites gracilis* Kiparisova (= *Columbites gracilis* Bajarunas MS), and *Tirolites rossicus* Kiparisova.

In the volume on the stratigraphy of the USSR, Kiparisova (1958a) contributed some additional data on the Mangyshlak sequence and the faunal associations. She states that the sequence begins with up to 250 m of calcareous shales of which the lower 10 m consist of sandy shale and coarse sandstone with lenses of conglomerate. Above the lower sandy bed, the shales contain beds of limestone with abundant ammonoids (*Doricranites bogdoanus* v. Buch, *Tirolites cassianus* Quenstedt, *Procarnites andrusovi* Kiparisova, *Pseudosageceras multilobatum* Noetling, etc.) and pelecypods. Above this are up to 400 m of argillaceous and sandy shales with interbedded limestone and sandstone. The limestones contain ammonoids (*Columbites* cf. *parisianus* Hyatt and Smith, *Tirolites cassianus* Quenstedt, *Procarnites andrusovi* Kiparisova, *Anasibirites gracilis* Kiparisova, and others) plus pelecypods, gastropods, and brachiopods. Kiparisova placed these horizons in the upper half of the Scythian.

TABLE 19. STRATIGRAPHY AND FAUNAS OF SCYTHIAN STRATA ON THE MANGYSHLAK PENINSULA AFTER ASTAKHOVA (1960 a, b; 1964). THE SPECIES MARKED WITH AN ASTERISK WERE ONLY LISTED BY ASTAKHOVA; THEY WERE NEITHER DESCRIBED NOR ILLUSTRATED.

TYUR-UPA SUITE (750–800m)	sandstone shale member	*Stacheites* Zone	*Leiophyllites radians* Astakhova *Nannites bajarunasi* Astakhova **Paranannites aspenensis* Hyatt and Smith **Stacheites prionoides* Kittl
	shale member	*Columbites* Zone	*Albanites danispanensis* Astakhova *Anasibirites subgracilis* Astakhova *Anasibirites gracilis* Kiparisova **Olenekites tururpensis* Astakhova *Olenekites mangyshlakensis* Astakhova *Procolumbites karataucikus* Astakhova *Columbites constrictilis* Astakhova **Columbites parisianus* Hyatt and Smith *Columbites dolnapaensis* Kiparisova
		Tirolites Zone	*Dinarites undatus* Astakhova *Kashmirites subdimorphus* Kiparisova *Kashmirites contortus* Astakhova *Tirolites impolitus* Astakhova *Tirolites elegans* Astakhova **Tirolites smiriagini* (Auerbach) **Tirolites cassianus* (Quenstedt) **Tirolites spinosus* Mojsisovics **Tirolites rossicus* Kiparisova
	limestone-shale member	*Pseudosageceras* Zone	*Procarnites andrusovi* Kiparisova **Pseudosageceras multilobatum* Noetling
		Doricranites Zone	*Doricranites tumulosus* Astakhova *Doricranites lanceolatus* Astakhova **Doricranites rarecostatus* Astakhova **Doricranites discus* Astakhova *Doricranites scharicus* Astakhova **Doricranites ovatus* Astakhova *Doricranites rossicus* (Mojsisovics) *Doricranites bogdoanus* (v. Buch) *Doricranites acutus* (Mojsisovics) *Subdoricranites discoides* Astakhova *Subdoricranites orbiculatus* Astakhova *Kiparisovites carinatus* Astakhova

Related to Bajarunas' interpretation of the age of the *Doricranites* beds was the conclusion that the Permian-Triassic formations on the Mangyshlak Peninsula were gradational. In both these conclusions, Bajarunas received support from Shevyrev and Shlezinger (1960). These authors state that throughout the entire extent of the Kara-Tau Range there are no signs, even the most indirect, of an interruption in sedimentation or of a basal conglomerate. They likewise are emphatic that the lower horizon with the *Doricranites* fauna does not contain *Tirolites*, as had been claimed by some authors. The short paper by Shevyrev and Shlezinger (1960) suffers from the same vague and incomplete data that characterized the contributions of Bajarunas (1936) and Kiparisova (1947, 1958a).

For the first comprehensive discussion of the stratigraphy and faunas of the Scythian formations on the Mangyshlak Peninsula we are indebted to Astakhova (1960a, b,

TABLE 20. SUMMARY LIST OF SPECIES RECOGNIZED IN THIS REPORT FROM EACH OF THE ZONES ESTABLISHED BY ASTAKHOVA (1960 a, b) IN THE SCYTHIAN OF THE MANGYSHLAK PENINSULA.

Stacheites Zone	*Leiophyllites radians*
	Arnautoceltites bajarunasi
Columbites Zone	*Albanites triadicus*
	Epiceltites subgracilis
	Olenekites mangyshlakensis
	Procolumbites karataucikus
	Pseudoceltites dolnapaensis
Tirolites Zone	*Dinarites undatus*
	Eukashmirites subdimorphus
	Eukashmirites contortus
	Tirolites rossicus
	Tirolites impolitus
Pseudosageceras Zone	*Procarnites kokeni*
Dorikranites Zone	*Prohungarites carinatus*
	Dorikranites bogdoanus
	Dorikranites acutus

1964). This author considered the Scythian strata, which she named the Tyur-Upa Suite, to be transgressive on the underlying Permian (Dolnapa Suite) formations. The basal 6–10 m of strata are stated to contain lenticular beds of conglomerate which include pebbles of the underlying red Permian Dolnapa Suite. Astakhova recognized a sequence of three lithologic members and five faunal zones within her Tyur-Upa Suite. These data are summarized on Table 19. The *Doricranites* Zone was correlated with the "*Meekoceras*" beds of the Himalayas, the Primorye Region, and Timor. The *Pseudosageceras* Zone was correlated with the *Hedenstroemia* beds of the Himalayas, the *Flemingites* beds of Timor, the *Flemingites* beds of the Primorye Region, and the *Pseudosageceras* beds of the western United States. The *Tirolites* Zone was correlated with the *Tirolites* Zone of the eastern Alps and of southeast Idaho. The *Columbites* Zone was correlated with the *Subcolumbites* fauna of the Primorye Region, the *Olenekites* fauna of northern Siberia, and the *Columbites* fauna of southeast Idaho. The *Stacheites* Zone was correlated with the *Prohungarites* Zone of Spath (1934).

Astakhova thus concluded that her Tyur-Upa Suite included all of the Scythian except for the lowest zone (*Otoceras*). Careful analysis of the described and illustrated species leads me to a quite different conclusion: that all of the Mangyshlak faunas belong to a single zone, that of *Prohungarites*. In the systematic portion of this paper each of the species from the Tyur-Upa Suite is discussed. A summary of the species that I recognize in each of Astakhova's zones is listed on Table 20.

Afghanistan

Excellent exposures of Lower Triassic Scythian strata occur at Kotal-e-Tera, 90 kilometers southeast of Kabul. A well preserved and diverse *Owenites* fauna has been described from this locality by Kummel and Erben (1968). A unique feature of this *Owenites* fauna is its complete mixing with a typical *Anasibirites* fauna. The beds containing the *Owenites* fauna are 75 feet thick and are overlain by 14 feet of strata that have yielded a poorly preserved *Subcolumbites* fauna. Kummel (1968) has recorded the following species from these beds:

Pseudosageceras multilobatum Noetling
Subvishnuites sp. indet.
Subvishnuites cf. *enveris* Arthaber
Xenoceltites sp. indet.
Procarnites kokeni (Arthaber)
Isculitoides cf. *originis* (Arthaber)
Subcolumbites perrinismithi (Arthaber)
Vickohlerites cf. *sundaicus* (Welter)
Meropella cf. *plejanae* Renz and Renz
Albanites triadicus (Arthaber)
Keyserlingites sp. indet.
Leiophyllites sp. indet.

These strata are overlain by black mudstones containing an Anisian fauna.

Salt Range, West Pakistan

The Ceratite beds of the Salt Range, West Pakistan, occupy an important place

in the development of Lower Triassic (Scythian) chronology. The geology of the Salt Range and Trans-Indus ranges was first monographed by Wynne (1878, 1880), and the ammonites monographed by Waagen (1895). In establishing a standard chronologic scheme for Triassic marine facies, Mojsisovics, Waagen, and Diener (1895) proposed the sequence of zones of the Salt Range as the type for the Lower Triassic. At that time the Ceratite beds were thought to comprise the entire Lower Triassic. It has long been recognized that, with a very few exceptions, the ammonoids from the Salt Range described by Waagen (1895) came from zones representing only parts of the middle and lower part of the Scythian.

A complete restudy of the Triassic formations in the Salt Range and Trans-Indus ranges has been published by Kummel (1966). The Ceratite beds of Wynne and Waagen have been named the Mianwali Formation, including three members: Kathwai, Mittiwali, and Narmia. Nearly all of Waagen's (1895) ammonoids came from the Mittiwali Member. The Narmia Member is approximately equivalent to the Dolomite group of Waagen (1895). From this stratigraphic horizon, Waagen (1895) described a single ammonoid specimen as *Pseudharpoceras spiniger*. Waagen considered this species to be closely related to the genus *Tropites* and concluded that it indicated a late Triassic (Keuper) age. It should be pointed out that *Pseudharpoceras spiniger* is based on a single specimen from an unknown horizon, but thought by Waagen to be from the topmost limestone unit of his Dolomite group in the Sheik-Budin Hills in the Trans-Indus Region. In addition, Waagen described *Dinarites sinuatus*, *Lecanites laqueus*, and *Lecanites planorbis* from his Bivalve beds, the basal unit of the Narmia Member.

Kummel's (1966) extensive field studies of the Triassic formation in the Salt Range and Trans-Indus ranges yielded a small, and generally poorly preserved fauna including the following species:

Pseudosageceras multilobatum Noetling
Subvishnuites sp. indet.
Xenoceltites sinuatus (Waagen)
Xenoceltites sp. indet.
Procarnites kokeni (Arthaber)
Isculitoides sp. indet.
Anakashmirites sp. indet.
Svalbardiceras sp. indet.
Stacheites sp. indet.
Dagnoceras sp. indet.
Nordophiceras planorbis (Waagen)
Nordophiceras cf. *planorbis* (Waagen)
Arctomeekoceras sp. indet.
Tirolites sp. indet.
Prohungarites cf. *crasseplicatus* (Welter)

India

Scythian strata have been recognized in the Himalayas for a century and have occupied an important role in the development of Scythian paleontology and stratigraphy. However, most of the abundant Scythian faunas known from Spiti to Kashmir belong to the lower half of that stage. The youngest Scythian horizon known is that of *Sibirites spiniger* from Byans which is equivalent to the *Anasibirites* Subzone of the *Owenites* Zone, approximately mid-Scythian in age.

A late Scythian horizon is probably present in Kashmir as shown by the presence of *Prohungarites middlemissii* (Diener, 1913). This species is quite similar to *Prohungarites mckelvei* n. sp. from the upper Thaynes Formation of southeast Idaho. The genus *Prohungarites* is known from the Mangyshlak Peninsula, the Salt Range, Timor, Olenek region, Nevada, and southeast Idaho in horizons here considered late Scythian in age. The Kashmir species, however, was collected from loose blocks and no stratigraphic data are available.

Recently, Tozer (1965a) has suggested that the horizon of *Keyserlingites dieneri* in the Himalayas may be upper Scythian in age rather than lower Anisian, as concluded by Diener, Spath, and others. The age assignment of these beds has a sufficient number of ambiguities to warrant a thorough re-analysis.

Krafft and Hayden measured the following section near Lilang in Spiti (Diener, 1912:56):

4.	Dark grey limestone, often concretionary with shaly partings. Upper Muschelkalk	22 ft.
3f.	Grey limestone with *Ceratites ravana*	16 in.
3e.	Grey concretionary limestone	6 in.
3d.	Shales with *Spiriferina stracheyi*	4 in.
3c.	Grey limestone	3 in.
3b.	Hard, grey limestone with *Keyserlingites dieneri*	4 in.
3a.	Thin layers of grey limestone and shale	3 ft.
2.	Nodular limestone (Niti limestone of Noetling)	60 ft.
1.	Shaly limestone with *Rhynchonella griesbachi*	3 ft.

Krafft measured the following section in 1900 at the Bambanag Cliff (Diener, 1912:57):

4.	Upper Muschelkalk with numerous specimens of *Ptychites, Hollandites, Beyrichites khanikoffi, Gymnites vasantasena*	20 ft.
3i.	Shales with many concretions, containing *Spiriferina stracheyi*	2 ft.
3h.	Dark grey limestone with *Spiriferina stracheyi* and *Spirigera stoliczkai*	1 ft.
3g.	Black shales	5 in.
3f.	Dark grey limestone with *Keyserlingites dieneri, Monophyllites hara, M. kingi, Spiriferina stracheyi, Spirigera stoliczkai*	5 in.
3e.	Black shale	2 in.
3d.	Limestone as 3f containing *Gymnites* sp.	7 in.
3c.	Black shales	5 in.
3b.	Limestone as 3h with *Monophyllites* sp. and *Dalmatites ropini*	6 in.
3a.	Black shales with *Keyserlingites* sp.	5–6 in.
2.	Nodular limestone (Niti limestone of Noetling) unfossiliferous	50 ft.
1.	Earthy limestone with *Rhynchonella griesbachi* and *Retzia himaica*	3 ft.

Thus the basic pattern of this stratigraphic interval is a thin limestone unit with *Rhynchonella griesbachi*, followed by a thick nodular, essentially unfossiliferous, limestone, then about six feet of limestone and shale, with *Keyserlingites dieneri*, etc., and at the top limestones with an abundant Anisian fauna. Diener (1912:55) emphasizes the homogeneity of this sequence of facies between Spiti and Painkhanda. In regards to the cephalopod faunas of the Lower Muschelkalk, the sections at Spiti have yielded a considerably larger number of species than those of Painkhanda. A tabulation of the species Diener (1907) described from these Lower Muschelkalk sections is given on Table 21. There are only four species which are common to the two districts. For some reason, Tozer (1965a:11) based his argument mainly on the fauna from Bambanag Cliff; however, if we accept the correlation of strata as proposed by Diener, the large number of unquestionable Anisian species from the Spiti sections does not support a suggestion that these strata and faunas could be late Scythian in age. There is an additional bit of evidence that lends support to Diener's conclusions, and this is the fauna from the Middlemiss Crag near Chitichun. This is a fauna from "exotic" blocks that has six species in common with that of the Lower Muschelkalk of Spiti, and two species in common with the Lower Muschelkalk at Painkhanda (Table 21). The presence of such genera as *Psilosturia, Procladisites,* etc., clearly indicates that this is Anisian in age; however, *Keyserlingites* is not present in this fauna.

Timor

Among the several beautifully preserved faunas of Scythian age from Timor, only one, that of "Block E bei Nifoekoko," is of late Scythian age. Welter (1922) described the following species from this fauna:

Columbites sp. ind.
Monophyllites sp. ind. ex aff. *dieneri* Arthaber
Palaeophyllites steinmanni Welter
Proptychites arthaberi Welter
Hungarites cf. *middlemissi* Diener
Hungarites crasseplicatus Welter
Hungarites tuberculatus Welter
Pronorites arbanus Arthaber
Pronorites sp. ind. ex aff. *arbani* Arthaber

Welter (1922) noted that five of his nine species were related to species of the *Subcolumbites* fauna of Albania described by Arthaber (1908, 1911). He, however, placed the horizon of this fauna at about that of

TABLE 21. SUMMARY LIST OF SPECIES FROM THE LOWER MUSCHELKALK OF THE HIMALAYAS, TIBET AND TIMOR. DATA FROM DIENER (1895, 1907) AND WELTER (1915).

	Gyundi R., Spiti	Lilang, Spiti	Po, Spiti	Shalshal Cliff	Bambanag Cliff	Middlemiss Crag	Timor (Welter Bed 2)	Timor (Welter Bed 3)
Hollandites vyasa Diener	×							
Danubites kansa Diener	×					×		
Danubites ambika Diener						×		
Danubites alternecostatus (Welter)							×	
Danubites compressus (Welter)							×	
Keyserlingites dieneri Mojsisovics		×		×	×			
Keyserlingites pahari Diener		×						
Keyserlingites pagoda Diener			×					
Keyserlingites angustecostatus Welter								×
Japonites ugra Diener		×				×	×	
Japonites meridianus Welter							×	
Japonites raphaelis zojae Tommasi							×	
Stacheites webbianus Diener		×						
Dalmatites ropini Diener		×			×			
Sibirites prahlada Diener		×						
Sibirites pandya Diener						×		
Gymnites depauperatus Diener		×						
Gymnites volzi Welter							×	
Procladiscites yasoda Diener						×	×	
Psilosturia mongolica (Diener)						×	×	
Megaphyllites evolutus Welter							×	
Leiophyllites confucii (Diener)		×				×		
Leiophyllites pradyumna (Diener)		×				×		
Leiophyllites middlemissii (Diener)						×		
Leiophyllites pitamaha (Diener)						×		
Leiophyllites laevis (Welter)							×	
Leiophyllites indoaustralica (Welter)							×	×
Ussurites hara (Diener)		×		×	×	×	×	×
Ussurites kingi (Diener)		×			×	×		
Rommanites cf. *simionescui* Kittl							×	

his *Owenites* limestone and approximately mid-Scythian in age.

The British Museum (Natural History) has large collections of Timor Scythian ammonoids. In the British Museum catalogue of Triassic ammonoids, Spath (1934) described a few new species from these blocks at Nifoekoko which are characterized by the manganese coating on the specimens. Kummel (1968) has likewise described new species from this fauna. In this report the species of ammonites recognized in the Nifoekoko fauna (with manganese coated specimens) are as follows:

Proptychitoides arthaberi (Welter)
Procarnites kokeni (Arthaber)
Isculitoides originis (Arthaber)
Prenkites timorensis Spath
Dagnoceras zappaneuse Arthaber
Metadagnoceras freemani Kummel
Albanites triadicus (Arthaber)
Prohungarites crasseplicatus (Welter)
Prohungarites tuberculatus (Welter)
Eophyllites orientalis Spath
Palaeophyllites steinmanni Welter

Included as a member of the *Prohungarites* Zone fauna of Timor is *Prenkites sundaicus* Welter. The one specimen on which this species is based came from Noel Niti, Timor, but no identifiable associated forms are known. This specimen has been selected as the type of a new genus, *Vickohlerites* Kummel (1968a).

Tozer (1965a:12) has suggested that the beds on Timor with *Keyserlingites angustecostatus* Welter are possibly late Scythian

in age. The fact that the Triassic of Timor is represented only by isolated blocks and that extremely condensed sections (within the blocks) are common has complicated interpretation of many of the Timor faunas. Most of the species that Welter (1915) assigned to the Anisian came from a single block of limestone within which three distinct layers were recognized. One of these layers, 60 cm thick, contained a typical Anisian fauna of 8 species, including *Acrochordiceras* (*Paracrochordiceras*) *anodosum* Welter, *Gymnites* sp., etc. Adjacent to this was a 30 cm thick unit with 14 species of ammonites which are listed in Table 21 (Welter's bed 2). Four of these species were first described from the Lower Muschelkalk of the Middlemiss Crag of Tibet, namely *Japonites ugra* Diener, *Procladiscites yasoda* Diener, *Psilosturia mongolica* (Diener), and *Ussurites hara* (Diener). Two of these species were first described by Diener from the Lower Muschelkalk at Lilang, Spiti (beds which contain *Keyserlingites dieneri*), namely *Japonites ugra* Diener and *Ussurites hara*. Tozer (1965a:12) agrees that this 30 cm unit is "undoubtedly Anisian" in age. Adjacent to this unit is a third, of 100 cm in thickness from which Welter recognized only three species, *Keyserlingites angustecostatus*, *Ussurites hara* (Diener) and *Leiophyllites indoaustralica* (Welter). It is this fauna that suggests to Tozer the possibility of an upper Scythian age on the basis that the two associated species "do not establish an Anisian age." However, *Ussurites hara* (Diener) and *Leiophyllites indoaustralica* occur also in Welter's unit 2 and *Ussurites hara* occurs in the Himalayas at Spiti, Painkhanda, and at the Middlemiss Crag, all units with an abundant Anisian fauna. Finally, among the specimens of *Keyserlingites angustecostatus* Welter in the British Museum, three fragments are from a "large block with *Gymnites* and *Leiophyllites*, etc., that also yielded *Parasageceras*" Spath (1934:359). The facts regarding these Timor faunas do not support the suggestion that the 100 cm layer with *Keyserlingites angustecostatus* may be late Scythian in age.

New Zealand

Scythian ammonoids are extremely rare in New Zealand where only two small faunas have been discovered. The first of these faunas consisted of only 9 specimens placed in 4 species of *Owenites* Zone age (Kummel, 1959). The second fauna consisted of 24 specimens of a single species, *Prosphingites coombsi* Kummel (1965). The morphological characters of this species and its genetic relationships suggest that it is of late Scythian (*Prohungarites* Zone) age. *Prosphingites coombsi* is extremely close to *Prosphingites insularis* Kiparisova from the *Subcolumbites* fauna of the Primorye Region.

China

Our knowledge of the upper Scythian of China is derived mainly from a monograph by Chao (1959) on ammonite faunas from Kwangsi Province. Chao adopted the stratigraphic divisions of Spath (1934), and for the Columbitan division he recognized three zones:

Columbitan division
- *Procarnites-Leiophyllites* Zone
- *Columbites costatus* Zone
- *Tirolites darwini* Zone

An analysis of all of the taxa recognized by Chao in these upper Scythian zones is included in the taxonomic portion of this paper. The stratigraphic data are somewhat ambiguous but do not tend to support Chao's interpretation.

The *Tirolites* Zone was recognized on the basis of a single, poorly preserved fragment of body chamber collected from an isolated horizon 3 km southwest of Pachuan in the Fengshan district, Kwangsi. The identification of this ammonoid fragment is highly dubious. This, coupled with the complete lack of any associated fauna or stratigraphic data, leads me to reject this as a valid record of the so-called *Tirolites* Zone.

The remaining portion of Chao's Columbitan fauna is represented in three sections in western Kwangsi—the Naliling, the Yali, and the Chashanao.

The Naliling section is developed about one kilometer northeast of Lolou village and was divided by Chao (1959:158) into three divisions. The lower unit is composed of 15 m of black, thin bedded limestone. The middle unit is composed of grey, thin bedded limestone and calcareous shales, about 40 m thick. The upper unit consists of black, well bedded limestone 15–20 m thick, but the upper part of this unit is cut off by a fault. The lower unit contains an *Owenites* fauna. From the calcareous shale beds of the middle unit, Chao (1959) identified the following species (collections 541a, b of Chao):

Prosphingites lolouensis Chao
Meekoceras sp. indet.
Columbites asymmetricus Chao
Columbites ? sp.
Isculitoides sp.
Digitophyllites lolouensis Chao
Anakashmirites ? sp.

From the upper unit, below the fault, Chao (1959) recognized the following species (collections 542a of Chao):

Paranannites subglobosus Chao
Prosphingites involutus Chao
Columbites asymmetricus Chao
Prenkites kwangsiensis Chao
Dagnoceras ellipticum Chao
Hellenites praematurus (Arthaber)
Celtites sp.

Within the village of Lolou, Chao (1959) uncovered an isolated limestone block from which he identified the following species of ammonites (collection 542b of Chao):

Procarnites oxynostus Chao
Procarnites acutus Spath
Cordillerites orientalis Chao
Proptychitoides compressus Chao
Tunglanites lenticularis Chao
Paranannites subglobosus Chao
Isculitoides ellipticus Chao
Isculitoides aff. *originis* (Arthaber)
Xenoceltites crenoventrosus Chao
Xenoceltites compressus Chao
Leiophyllites oxynostus Chao[1]
Leiophyllites lolouensis Chao[1]
Leiophyllites serpentinus Chao
Digitophyllites lolouensis Chao
Submeekoceras compressum Chao
Submeekoceras lolouense Chao
Submeekoceras longiseptatum Chao
Parussuria latilobata Chao
Anakashmirites aff. *nivalis* Diener
Lecanites sp.

The Yali section, in the Fenghan district, is stated by Chao (1959:173) not to have been well studied. It apparently represents a collection of ammonites (horizon 546 of Chao) from an unmeasured section. Chao identified the following ammonites from this section:

Proptychitoides ? *simplex* Chao
Columbites yaliensis Chao
Columbites huangi Chao
Columbites costatus Chao
Paranannites involutus Chao
Paranannites minutus Chao
Prenkites kwangsianus Chao
Fengshanites robustus Chao
Dagnoceras latilobatum Chao
Hellenites praematurus (Arthaber)

The Chashanao section lies on the border of the Hochih and Tunglan districts. The Scythian strata here consist of only 17 m of strata resting unconformably on Lower Permian limestones. Near the top of this sequence a 0.6 m bed of black limestone yielded the following ammonites, identified by Chao (1959, his horizon 610):

Subcolumbites kwangsianus Chao
Columbites huangi Chao
Isculitoides globosus Chao
Tunglanites lenticularis Chao
Paradinarites suni Chao
Anakashmirites sp.
Proptychitoides tunglanensis Chao
Henilecanites discus Arthaber

Chao concludes that the fauna of his collections 541a, b, 546, and 610 is es-

[1] In the list of species from this collection Chao (1959:160) does not include these two species. Instead, he has *Leiophyllites kwangsiensis* Chao sp. nov. and *L. vermiformis* Chao sp. nov.; however, neither of these species is described in the taxonomic portion of his monograph. The two species listed above are from collection 542b.

TABLE 22. SUMMARY LIST OF SPECIES RECOGNIZED IN THIS REPORT FROM THE LATE SCYTHIAN OF KWANGSI, CHINA, IN TERMS OF THE FIVE DISTINCT COLLECTIONS STUDIED BY CHAO (1959).

	Nalling Section Collection 541 a, b	Nalling Section Collection 542 a	Ls. Block, Lolou Village Col. 542 b	Yali Section Collection 546	Chashanao Section Collection 610
Cordillerites angulatus			×		
Xenoceltites crenoventrosus			×		
Hemilecanites discus					×
Proptychitoides tunglanensis			×	×	×
Procarnites kokeni			×		
Procarnites lolouensis	×		×		
Arnautoceltites involutus				×	
Prosphingites lolouensis	×				×
Prosphingites subglobosus		×	×		
Isculitoides ellipticus			×		
Tunglanites lenticularis			×		×
Subcolumbites perrinismithi	×	×			×
Subcolumbites robustus				×	
Paradinarites suni					×
Prenkites timorensis		×		×	×
Parussuria latilobata			×		
Dagnoceras ellipticum		×			
Dagnoceras latilobatum				×	
Nordophiceras compressum			×		
Hellenites praematurus		×		×	
Leiophyllites serpentinus			×		

sentially the same and comprises his Zone of *Columbites costatus*. Because a specimen identified as *Procarnites kokeni* was found from the top part of the Lower Triassic limestone sequence east of Lolou, Chao (1959:160) concludes that his collection 542b (the loose block) "may represent the highest horizon of the *Columbites* stage" and refers this fauna to his *Procarnites-Leiophyllites* Zone.

All of the taxa described by Chao from these sections are discussed in the taxonomic portion of this paper. This study leads me to conclude that there are only 21 species of ammonites in these four collections. These are listed on Table 22 along with their geographic occurrence. The limestone block, collection 542b, which Chao assigned to his *Procarnites-Leiophyllites* Zone, comprises 11 species. Four of these species occur in one or more of the remaining three collections. Of the seven remaining species, *Cordillerites angulatus* ranges throughout the upper half of the Scythian; the genus *Xenoceltites* ranges throughout the upper half of the Scythian and is not common in late Scythian formations; *Procarnites kokeni* is a common element of the *Subcolumbites* fauna of Albania and Chios, and it is also known from the Salt Range and from the *Prohungarites* fauna of Timor; the genus *Isculitoides* is apparently confined to the late Scythian and occurs in most localities where such faunas are known; *Parussuria latilobata* is the only species of this genus from a late Scythian horizon; *Nordophiceras* is known from the *Olenekites* fauna and *Dieneroceras* fauna of northern Siberia, the *Columbites* fauna of southeastern Idaho, and from the Salt Range of West Pakistan; forms like *Leiophyllites serpentinus* are common in the *Subcolumbites* fauna of Albania, Chios, and the Primorye Region.

I can see no actual difference in the faunal composition of collection 542b and collections 610, 542a, and 541a, b. Taking into account the factors of preservation, collection failure, and the composition of other late Scythian faunas, as those at Albania, Chios, Timor, Primorye, etc., plus the fact that there are no stratigraphic data on collection 542b, these four collections appear more likely to represent one single zone.

Japan

The present data on Triassic stratigraphy and ammonite faunas of Japan have been very ably summarized by Bando (1964a, 1966). The upper Scythian is represented by two specimens of *Subcolumbites perrinismithi* from the Osawa Formation in the Kitakami Massif.

Primorye Region

This is another of the classic areas that have occupied an important place in Scyth-

ian studies going back to 1895 when Diener published the first monograph on ammonites from this region. There have been a number of studies on the ammonites and pelecypods of these faunas; however, it is largely through the writings of Kiparisova (1947, 1961) that a picture of the stratigraphy and paleontology can be assessed. Korzh (1957, 1959) has contributed to our understanding of the petrography and paleogeography of the Primorye Scythian formations. Regional stratigraphic data as yet leave much to be desired. The Scythian formations of the Primorye Region represent 350–700 m of strata (Kiparisova, 1961: 191). Four assemblages of ammonites are recognized within these formations. Kiparisova (1961) named the lowest assemblage the *Proptychites* Zone, which she correlated with the Otoceratan and Gyronitan ages of Spath (1934). This assemblage is confined to 100–200 m of strata. In the overlying 50 m of strata a *Flemingites* Zone was recognized and correlated with the Flemingitan age of Spath (1934). The third faunal assemblage Kiparisova (1961) named the *Prosphingites* Zone. This assemblage is clearly identical to the *Meekoceras* fauna of the western United States. Recently, Kiparisova and Popov (1964) have presented evidence to the effect that the *Flemingites* Zone and *Prosphingites* Zone of the Primorye Region are equivalent, and they recommend excluding the *Flemingites* Zone from the Scythian time scale.

The fourth and uppermost faunal assemblage in the Primorye Scythian formations was named the *Subcolumbites* Zone by Kiparisova. This upper zone encompasses 100–150 m of strata. It is the fauna of this zone that is pertinent to this paper. Kiparisova (1961) recognized the following species from her *Subcolumbites* Zone:

Pseudosageceras simplex Kiparisova
Pseudosageceras longilobatum Kiparisova
Dieneroceras dieneri (Hyatt and Smith)
Xenoceltites spitsbergensis Spath
Prosphingites globosus Kiparisova
Prosphingites insularis Kiparisova
Subcolumbites multiformis Kiparisova
Subcolumbites solitus Kiparisova
Subcolumbites anomalus Kiparisova
Paranannites gracilis Kiparisova
Paranannites suboviformis Kiparisova
Paranannites minor Kiparisova
Leiophyllites praematurus Kiparisova
Eophyllites amurensis Kiparisova
Danubites (*Danubites*) *admaris* Kiparisova
Danubites (*Danubites*) *incertus* Kiparisova
Danubites (*Preflorianites*) *inflatus* Kiparisova
Danubites (*Preflorianites*) *maritimus* Kiparisova
Megaphyllites immaturus Kiparisova

The above species are apparently in direct association with *Subcolumbites*. In addition, there are four species from the upper Scythian formations of the Primorye Region whose relations with the *Subcolumbites* assemblage are not clear. First, there is *Hellenites* (?) *inopinatus* Kiparisova which occurs at Cape Zhitkov, a locality with a well developed *Subcolumbites* fauna. Next, there is *Prohungarites* (?) *popovi* Kiparisova from the strata on the west coast of Amur Bay which Kiparisova considers to be latest Scythian or earliest Anisian in age. Finally, there are two species—*Columbites* sp. indet. and *Dagnoceras* ? *unicum* Kiparisova—that Kiparisova lists separately as beneath the main *Subcolumbites* fauna.

Recent studies by Zakharov have greatly increased our knowledge of the stratigraphy and paleontology of the Primorye Scythian deposits. Zakharov (1966; additional personal communication, 1967) recognizes a single Scythian zone above that of *Owenites koeneni* to which he gives the name *Columbites parisianus* Zone. Within this zone he recognizes two subzones, a lower *Neocolumbites insignis* Subzone and an upper *Subcolumbites multiformis* Subzone. Zakharov's zonal scheme with the key species for each segment is as follows:

Columbites parisianus	*Subcolumbites multiformis*	*Prosphingites insularis* Kiparisova, *P. globosus* Kiparisova, *Subcolumbites multiformis* Kiparisova, *Prenkites* aff. *timorensis* Spath, *Paranannites gracilis* Kiparisova, *Megaphyllites immaturus* Kiparisova.
		Svalbardiceras parisense Zakharov, *Metadagnoceras unicum*

Neocolumbites insignis (Kiparisova), *Columbites parisianus* Hyatt and Smith, *Procolumbites* sp., *Neocolumbites insignis* Zakharov, *Keyserlingites meridianus* Zakharov, *Olenekites sonticus* Zakharov, *Hellenites inopinatus* Kiparisova, *H. tchernyschewiensis* Zakharov.

Zakharov's complete monograph on the Scythian faunas of the Primorye Region is not available to me at this moment. On the basis of the data available, the ammonoids of the *Subcolumbites* fauna of the Primorye Region include the following species:

Pseudosageceras multilobatum Noetling
Pseudosageceras simplex Kiparisova
Dieneroceras karazini n. sp.
Xenoceltites spitsbergensis Spath
Procarnites immaturus (Kiparisova)
Arnautoceltites gracilis (Kiparisova)
Prosphingites globosus Kiparisova
Prosphingites insularis Kiparisova
Isculitoides suboviformis Kiparisova
Subcolumbites multiformis Kiparisova
Prenkites aff. *timorensis* Spath
Leiophyllites admaris (Kiparisova)
Leiophyllites maritimus (Kiparisova)
Leiophyllites variabilis (Spath)

As mentioned above, Kiparisova (1961) was uncertain as to the precise horizon of *Prohungarites* (?) *popovi* Kiparisova. Zakharov (personal communication) informs me that he has found *Arctohungarites primoriensis* Zakharov, *Megaphyllites atlasoviensis* Zakharov, and *Leiophyllites praematurus* Kiparisova on the west coast of Amur Bay at a horizon 30 m below beds with *Prohungarites* (?) *popovi*, and concludes that it is an Anisian form. In this I agree.

One of the more important contributions that Zakharov has made toward our understanding of the Scythian of the Primorye Region is the recognition of the *Columbites* Zone which he assigned to his *Neocolumbites insignis* Subzone. In the monograph by Kiparisova (1961), it could only be inferred, primarily on the basis of stratigraphic position, that *Columbites* sp. indet. and *Dagnoceras unicum* most probably represented the *Columbites* Zone. Zakharov (personal communication) lists the following species from his *Neocolumbites insignis* Subzone:

Svalbardiceras parisense Zakharov
Metadagnoceras unicum (Kiparisova)
Columbites parisianus Hyatt and Smith
Procolumbites sp.
Neocolumbites insignis Zakharov
Keyserlingites meridianus Zakharov
Olenekites sonticus Zakharov
Hellenites inopinatus Kiparisova
Hellenites tchernyschewiensis Zakharov

Columbites parisianus is the name giver and primary member of the *Columbites* fauna of southeastern Idaho. In addition, the Idaho fauna also includes species of *Svalbardiceras*, *Keyserlingites*, and *Hellenites*. The relationship of the Primorye *Columbites* fauna with that of the *Dieneroceras* Zone of northern Siberia, which I consider equivalent to the *Columbites* fauna of southeast Idaho, is less direct; there is not a single genus or species in common. However, there is a close tie between the fauna of the *Dieneroceras* Zone of northern Siberia and the *Columbites* fauna of Idaho, especially in species of *Dieneroceras*, *Pseudaspidites*, and *Nordophiceras*.

Northeastern Siberia

Until a decade ago our knowledge of the Lower Triassic of northeastern Siberia rested almost entirely on two contributions of Mojsisovics (1886, 1888). In recent years our knowledge of this region has greatly increased, largely due to the writings of Yu. N. Popov. A summary of the stratigraphy of the major outcrop areas in this area of Siberia can be found in Popov (1958, 1960). Data on the sedimentology and paleogeography of the Permian and Lower Triassic formations in the Verkhoyansk Range can be found in Shutov (1958). The principal recent discussion of the ammonites of this region is in a monograph by Popov (1961).

In the general area of the Olenek River region, the Scythian comprises two facies and stratigraphic units. The lower unit is a clastic facies with *Estheria* and plant re-

mains; this is overlain by a marine clastic unit containing two ammonoid faunas—the *Dieneroceras* fauna of Popov, overlain by the *Olenekites* fauna. Further to the east, lower Scythian ammonoid horizons occur, but these are not the concern of this report.

The age and correlation of the *Olenekites* fauna have been under discussion ever since its monographic treatment by Mojsisovics (1886, 1888). This author recognized the following species in this fauna:

Dinarites spiniplicatus Mojsisovics
Dinarites volutus Mojsisovics
Dinarites densiplicatus Mojsisovics
Dinarites altus Mojsisovics
Dinarites intermedius Mojsisovics
Dinarites glacialis Mojsisovics
Dinarites laevis Mojsisovics
Dinarites tolli Mojsisovics
Ceratites sigmatoideus Mojsisovics
Ceratites multiplicatus Mojsisovics
Ceratites hyperboreus Mojsisovics
Ceratites fissiplicatus Mojsisovics
Ceratites discretus Mojsisovics
Ceratites middendorffi Keyserling
Ceratites schrencki Mojsisovics
Ceratites subrobustus Mojsisovics
Ceratites nikitini Mojsisovics
Ceratites bungei Mojsisovics
Ceratites decipiens Mojsisovics
Ceratites inostranzeffi Mojsisovics
Sibirites eichwaldi (Keyserling)
Sibirites pretiosus Mojsisovics
Xenodiscus euomphalus (Keyserling)
Xenodiscus schmidti Mojsisovics
Xenodiscus dentosus Mojsisovics
Meekoceras karpinskii Mojsisovics
Meekoceras rotundatum Mojsisovics
Meekoceras sibiricum Mojsisovics
Prosphingites czekanowskii Mojsisovics

In his recent monographic treatment of the Olenek fauna, Popov (1961 and 1962a) recognized the following species:

Pseudosageceras longilobatum Kiparisova
Columbites (?) aff. *ornatus* Smith
Columbites morpheos Popov
Tirolites ex gr. *cassianus* (Quenstedt)
Tirolites gerbaensis Popov
Sibirites eichwaldi (Keyserling)
Sibirites pretiosus Mojsisovics
Sibirites subpretiosus Popov
Parasibirites grambergi (Popov)
Parasibirites rariaculeatus Popov
Parasibirites mixtus Popov
Olenekites spiniplicatus Mojsisovics
Olenekites glacialis Mojsisovics
Olenekites altus Mojsisovics
Nordophiceras schmidti (Mojsisovics)
Boreomeekoceras keyserlingi (Mojsisovics)
Keyserlingites middendorffi (Keyserling)
Keyserlingites subrobustus (Mojsisovics)
Keyserlingites nikitini (Mojsisovics)
Prophingites czekanowskii Mojsisovics
Arctoceras simplex (Mojsisovics)
Procarnites kummeli Popov
Hemiprionites sibiricus (Mojsisovics)
Arctomeekoceras rotundatum (Mojsisovics)
Anasibirites raricostatus Popov
Pseudotirolites menensis Popov

My own analysis of this fauna leads me to believe it consists of the following species:

Pseudosageceras multilobatum Noetling
Preflorianites multiplicatus (Mojsisovics)
Proptychitoides kummeli (Popov)
Prosphingites czekanowskii Mojsisovics
Czekanowskites decipiens (Mojsisovics)
Svalbardiceras schmidti (Mojsisovics)
Svalbardiceras dentosus (Mojsisovics)
Svalbardiceras sibiricum (Mojsisovics)
Nordophiceras pseudosimplex n. sp.
Arctomeekoceras rotundatum (Mojsisovics)
Boreomeekoceras keyserlingi (Mojsisovics)
Sibirites pretiosus (Mojsisovics)
Keyserlingites middendorffi (Keyserling)
Keyserlingites subrobustus (Mojsisovics)
Olenekites spiniplicatus (Mojsisovics)
Tirolites morpheos (Popov)
Arctotirolites menensis Popov

Smith (1932) considered the *Olenekites* fauna as correlative with the *Columbites* fauna of southeast Idaho and the youngest zone of the Lower Triassic. Spath (1934) expressed considerable concern over correlation of the Olenek fauna, clearly recognizing the problem as it then existed. He concluded, however, that the Olenek fauna was latest Scythian in age and even suggested that his latest division of the Scythian could just as well be named Olenekitan. The time relationship of the *Olenekites* fauna and the *Prohungarites* fauna was clarified by the discovery of elements of these faunas associated together at a horizon approximately 1000 feet above the *Columbites* fauna in southeastern Idaho (Kummel, 1954). Popov (1961) concluded that the *Olenekites* Zone was correlative with the *Columbites* Zone. Kiparisova and Popov (1956) had previously arrived at a

similar conclusion. At a later date, Kiparisova and Popov (1961) accepted the *Prohungarites* Zone as being younger than the *Columbites* Zone and correlated the *Olenekites* fauna with it.

In a recent contribution, Kiparisova and Popov (1964) correlated the *Olenekites* fauna with the *Columbites* and *Tirolites* faunas of southeast Idaho, and recorded an additional younger zone, that of *Prohungarites tuberculatus* Welter. Descriptions of the fossils and stratigraphic sequence of this new assemblage are apparently in press. It is reasonable to expect that in this northern Siberian region two local zones could be useful for detailed stratigraphic analysis. On the other hand, on the basis of the data available, it appears more plausible that these two local zones are correlative with the *Prohungarites* Zone as interpreted here. The correlation of the *Olenekites* fauna with the *Columbites* fauna of southeast Idaho has no basis whatsoever.

This brings us to the problem of correlation of the *Dieneroceras* Zone of Popov. That author (Popov, 1961, 1962a) recognized the following species in this zone:

Pseudosageceras longilobatum Kiparisova
Dieneroceras demokidovi Popov
Dieneroceras apostolicus (Smith)
Dieneroceras khelaliensis Popov
Dieneroceras nikabitensis Popov
Nordophiceras karpinskii (Mojsisovics)
Nordophiceras alexeevae Popov
Nordophiceras olenekensis Popov
Nordophiceras contrarius Popov
Koninckites posterius Popov
Inyoites eiekitensis Popov
Hemiprionites costatus Popov

My own analysis of this fauna leads me to believe it contains the following species:

Pseudosageceras multilobatum Noetling
Dieneroceras demokidovi Popov
Dieneroceras apostolicus (Smith)
Subvishnuites eiekitensis (Popov)
Pseudaspidites posterius (Popov)
Nordophiceras euomphalus (Keyserling)
Nordophiceras alexeevae Popov
Hemiprionites costatus Popov

Popov (1962a) concluded that the fauna of his *Dieneroceras* Zone was correlative with the *Owenites* Zone of the circum-Pacific region. In a personal communication, he further stated that he believed his fauna to be correlative to the *Anasibirites* Zone (upper *Owenites*). This correlation was followed by Kiparisova and Popov (1964). The conclusion arrived at here that the *Dieneroceras* Zone fauna of Popov is of *Columbites* Zone age is based primarily on the close relations and possible identity of the species of *Dieneroceras, Subvishnuites, Pseudaspidites,* and *Nordophiceras* with the forms in the *Columbites* fauna of southeast Idaho.

Spitsbergen

There is a considerable literature on Triassic stratigraphy and ammonoids of Spitsbergen. An extensive review of the older literature of the Triassic stratigraphy and paleontology with much new data has recently been published by Buchan, et al. (1965). The late Scythian is represented by only three species of ammonoids: *Keyserlingites subrobustus* and *Svalbardiceras spitzbergensis* Frebold, and *Svalbardiceras schmidti* (Mojsisovics). These are typical representatives of the late Scythian (*Prohungarites* Zone) fauna of the circum-Arctic region.

Ellesmere Island

A number of localities in the Blaa Mountain and Blind Ford formations of Ellesmere Island have yielded a small but highly interesting late Scythian fauna. Tozer (1961a, 1965a) has recognized the following species in these faunas:

Olenekites canadensis Tozer
Svalbardiceras freboldi Tozer
Keyserlingites subrobustus (Mojsisovics)
Popovites borealis Tozer
Zenoites arcticus Tozer

The above assemblage of species includes several very typical late Scythian forms of the circum-Arctic region. Underlying the horizon which yields the above fauna, Tozer (1965a) records *Nordophiceras pilatum* (Hyatt and Smith) "associated with small

ammonoids, probably *Columbites* sp." This appears to identify the presence of the *Columbites* Zone.

British Columbia

Late Scythian ammonoids are apparently rare in British Columbia. Recently Tozer (1965a) has described a small fauna from three localities in northeastern British Columbia in the "Toad-Grayling Formation." All the specimens come from a 20–30 foot bed within the formation. From these three localities Tozer (1965a) has recognized the following species:

Procarnites modestus Tozer
Keyserlingites subrobustus (Mojsisovics)
Popovites occidentalis Tozer
Pseudosageceras bicarinatum Tozer
Leiophyllites sp. indet.
Prosphingites cf. *P. czekanowskii* Mojsisovics
Preflorianites intermedius Tozer
Monacanthites monoceras Tozer
Metadagnoceras pulcher Tozer
Svalbardiceras chowadei Tozer
Isculitoides minor Tozer

My own analysis of this small fauna, consisting of 41 specimens, leads me to conclude that *Procarnites modestus* is a synonym of *Procarnites immaturus* (Kiparisova) from the Primorye Region and that *Pseudosageceras bicarinatum* is a synonym of *Cordillerites angulatus* Hyatt and Smith.

Tobin Formation, Nevada

The geology of the Tobin Formation, as it is developed in the Mount Tobin quadrangle, Nevada, has been ably discussed by Muller, et al. (1951). These authors recognized the Scythian age of the formation and recorded the following fossils from it: *Claraia* cf. *C. aurita*, *Myopharia* sp., *Lingula* sp., *Subcolumbites* sp., *Hungarites* sp. In addition, Muller has shown the author specimens of *Olenekites* from the Tobin Formation; the precise locality and horizon within the formation of these *Olenekites* is not known to the writer.

In 1959, in company with N.J. Silberling, then of the U.S. Geological Survey, we discovered a fossiliferous bed with well preserved specimens a few tens of feet above the base of the Tobin Formation. This site has become USGS Mesozoic locality M2562 and is described geographically as follows (Silberling, written communication): "Pershing County, Nevada. South tip of Tobin Range, Cain Mountain 1:62,500 quad. Center NW ¼ Sec. 9, T. 26 N., R. 39 E. 5,500 feet south, 27.5 west from elevation point 5088 on range crest." The fauna we collected from this site yielded the following species:

Subcolumbites americanus n. sp.
Arnautoceltites teicherti n. sp.
Stacheites floweri n. sp.
Isculitoides wasserbergi n. sp.
Ussurites sieveri n. sp.
Metadagnoceras tobini n. sp.
Hemilecanites paradiscus n. sp.

In the general vicinity of USGS locality M2562 talus blocks of unknown stratigraphic position within the Tobin Formation have yielded the following species:

Pseudosageceras multilobatum Noetling
Keyserlingites sp. indet.
Hellenites radiatus Renz and Renz
Prohungarites mckelvei n. sp.
Prohungarites sp. indet.

Confusion Range, Utah

The Thaynes Formation, including a series of fossiliferous horizons, is well developed in the Confusion Range of west-central Utah (Hose and Repenning, 1959). The lower beds of the Thaynes Formation, containing an abundant *Meekoceras* fauna, rest on the Gerster Limestone of Permian age; there is thus a significant hiatus between these formations. A second horizon with ammonoids occurs from 1,100 to 1,120 feet above the base of the Thaynes Formation. N. J. Silberling (*in* Hose and Repenning, 1959:2188) has identified "*Ophiceras*"? *spencei* Hyatt and Smith and "*Ophiceras*"? *jacksoni* Hyatt and Smith from this fauna. These are species occurring in the *Columbites* fauna of southeast Idaho and a correlation with that fauna is suggested. Abundant ammonites, of poor to fair preservation, were found from 1,420 to 1,530

feet above the base of the Thaynes (USGS Collection M111). Silberling (*in* Hose and Repenning, 1959:2188) identified in this collection *Proptychitoides mahomedis* (Arthaber), *Xenoceltites* cf. *X. spitsbergensis* Spath, *Tirolites* cf. *T. spinosus* Mojsisovics, *T.* aff. *haueri* Mojsisovics, and *Pseudosageceras* sp. Through the courtesy of Dr. N. J. Silberling I have had the opportunity of studying USGS collection M111 and have identified the following species:

Ussurites hoesi n. sp.
Pseudoceltites nevadi n. sp.
Tirolites cf. *cassianus* (Quenstedt)
Pseudosageceras multilobatum Noetling

This fauna is of particular interest, as none of the genera are present in the *Prohungarites* fauna of the upper Thaynes Formation in southeast Idaho. The *Subcolumbites* fauna from the Tobin Formation of Nevada contains a species of *Ussurites* which, however, is quite distinct from the Confusion Range species. *Pseudoceltites* occurs in the *Owenites* Zone, *Columbites* Zone, and in the latest Scythian *Prohungarites* Zone. One species, *Pseudoceltites dolnapaensis* Kiparisova, is recorded from the *Columbites* Zone of Astakhova (1960b) on the Mangyshlak Peninsula. The *Columbites* fauna of southeast Idaho contains *Pseudoceltites cheneyi* n. sp. which is quite similar to *P. nevadi*. *Tirolites* likewise occurs through the upper half of the Scythian but is of no assistance in the dating of this fauna. Finally, *Pseudosageceras multilobatum* is present in all the Scythian faunal zones.

There are thus few direct data for precise age assignment of this fauna. It represents a distinctive assemblage of species not directly comparable to any other fauna. The stratigraphic position, lying above a horizon with species of *Columbites* Zone age, suggests that we can include this fauna within the late Scythian *Prohungarites* Zone.

Thaynes Formation, Southeast Idaho

The Thaynes Formation of southeast Idaho includes one of the most complete sequences of ammonoid faunas for the upper half of the Scythian. Extensive data on the stratigraphy and facies relations of the formation have been presented by Kummel (1954, 1957). In the general area of Bear Lake, in southeast Idaho, the Thaynes Formation contains five distinct ammonoid horizons. The basal unit of the formation is the lower limestone member of Kummel (1954) and contains an abundant *Meekoceras* fauna. Immediately overlying the lower limestone member is the lower shale member which contains a well developed *Anasibirites* fauna. There has been considerable debate as to whether these two faunas represent distinct zones or are part of a single zone. Recently, Kummel and Erben (1968) have presented new data that favor considering these two faunal horizons as subzones of the *Owenites* Zone of mid-Scythian age, as originally suggested by Smith (1932). Approximately 620 feet above the lower limestone unit with *Meekoceras*, occurs a small fauna of two species of ammonites: *Tirolites harti* and *Dalmatites attenuatus*. Smith (1932) correlated this fauna with that of the Werfen Formation of the Alps and adjoining regions and established a *Tirolites* Zone. The correlation of this fauna has been discussed in detail on page 342 in conjunction with the discussion of the Werfen fauna. The conclusion arrived at here is that this Idaho fauna is not correlative with the Werfen fauna but is more related to the overlying *Columbites* fauna, and should probably be considered as merely a local subzone of the *Columbites* Zone.

One thousand feet above the lower limestone member with *Meekoceras* is the middle shale member which contains the richly fossiliferous *Columbites* fauna. Smith (1932) described the following species of ammonites in this fauna from outcrops in Paris Canyon:

Ophiceras jacksoni Hyatt and Smith
Ophiceras spencei Hyatt and Smith
Meekoceras curticostatum Smith

Meekoceras micromphalus Smith
Meekoceras pilatum Hyatt and Smith
Meekoceras sanctorum Smith
Pseudharpoceras idahoense Smith
Tirolites cf. *illyricus* Mojsisovics
Pseudosageceras multilobatum Noetling
Celtites apostolicus Smith
Celtites planovolvis Smith
Celtites ursensis Smith
Columbites consanguineus Smith
Columbites ligatus Smith
Columbites minimus Smith
Columbites ornatus Smith
Columbites parisianus Hyatt and Smith
Columbites spencei Smith

Several new outcrops of the middle shale member have been encountered in the area around Bear Lake in southeastern Idaho, which have yielded an abundance of additional specimens. Examination of all of Smith's types and my own large collections yields the following species as comprising the *Columbites* fauna:

Pseudosageceras multilobatum Noetling
Cordillerites angulatus Hyatt and Smith
Dieneroceras apostolicus (Smith)
Subvishnuites sp. indet.
Xenoceltites spencei (Hyatt and Smith)
Preflorianites montpelierensis n. sp.
Pseudaspidites popovi n. sp.
Columbites parisianus Hyatt and Smith
Pseudoceltites cheneyi n. sp.
Svalbardiceras sheldoni n. sp.
Nordophiceras pilatum (Hyatt and Smith)
Nordophiceras jacksoni (Hyatt and Smith)
Keyserlingites stephensoni n. sp.
Tirolites smithi n. sp.
Tirolites astakhovi n. sp.
Tirolites sp. indet.
Hellenites idahoense (Smith)
Dalmatites kittli n. sp.
Ussurites mansfieldi n. sp.

Approximately 1000 feet above the middle shale member with the *Columbites* fauna is a unit consisting of a couple of hundred feet of gray-brown limestones and shales that have yielded the following fauna:

Pseudosageceras drinense Arthaber
Isculitoides hammondi n. sp.
Epiceltites gentii Arthaber
Svalbardiceras sp. indet.
Czekanowskites cf. *decipiens* Mojsisovics
Stacheites sp. indet.
Keyserlingites bearriverensis n. sp.
Keyserlingites bearlakensis n. sp.
Olenekites cf. *spiniplicatus* Mojsisovics
Prohungarites mckelvei n. sp.
Prohungarites gutstadti n. sp.
Prohungarites sp. indet.

Above this fossiliferous unit with *Prohungarites* are at least 600 feet more of strata, but these are very poorly preserved and have yielded no ammonites. The top contact of the Thaynes Formation is not exposed in the Bear River Range.

SYSTEMATIC PALEONTOLOGY[1]

Class *CEPHALOPODA* Cuvier, 1797
Subclass *AMMONOIDEA* Zittel, 1884
Order *PROLECANITIDA* Miller and Furnish, 1954
Superfamily *MEDLICOTTIACEAE* Karpinsky, 1889
Family *SAGECERATIDAE* Hyatt, 1900
Genus *Pseudosageceras* Diener, 1895
Type species, *Pseudosageceras multilobatum* Noetling, 1905

No other genus of Scythian ammonoid is as long ranging or as widely and abundantly distributed as *Pseudosageceras*. Approximately a dozen species have been recognized, most of which, however, were based on one or few specimens and are quite restricted in distribution. I recognize within the upper Scythian faunas of the world the following five species:

Pseudosageceras multilobatum Noetling
Pseudosageceras drinense Arthaber
Pseudosageceras albanicum (Arthaber)
Pseudosageceras pasquayi Renz and Renz
Pseudosageceras simplex Kiparisova

Among these species *pasquayi* and *simplex* are known only from single specimens at single localities. The species *albanicum*

[1] Abbreviations in this paper: MCZ = Museum of Comparative Zoology; BMNH = British Museum (Natural History); GSI = Geological Survey of India; PIUV = Paleontological Institute, University of Vienna; GPIBo = Geological Institute, Bonn University; NHMB = Natural History Museum Basel; USNM = United States National Museum; USGS = United States Geological Survey. No data on repository are given for species not personally examined by the author.

is fairly well represented in the *Subcolumbites* fauna of Albania and Chios, as is *drinense,* but the latter species is also known from a single specimen of late Scythian age from southeast Idaho. The above species are only known from uppermost Scythian horizons. The species which is universal in its distribution is *multilobatum.* There are few fossiliferous marine formations of Scythian age that have not yielded specimens of this species.

Pseudosageceras multilobatum Noetling
Plate 34, figure 6; Text-figure 2

Pseudosageceras multilobatum Noetling, 1905: 181, pls. 19–27; Frech, 1905: pl. 23, figs. 4, 5, pl. 25, fig. 1, pl. 26, fig. 3; Krafft and Diener, 1909: 145, pl. 21, fig. 5; Wanner, 1911: 181, pl. 7, fig. 4; Diener, 1915: 237; Diener, 1917: 173, pl. 1, fig. 13; Welter, 1922: 94, fig. 3; Diener, 1925: 96, fig. 26; Smith, 1932: 87, pl. 4, figs. 1–3, pl. 5, figs. 1–6, pl. 25, figs. 7–16, pl. 60, fig. 32, pl. 63, figs. 1–6; Kutassy, 1933: 630; Collignon, 1933: 24, pl. 11, fig. 2; Spath, 1934: 54, fig. 6a; Kiparisova, 1947: 127, pl. 25, figs. 3, 4; Kummel, 1954: 185–187; Chao, 1959: 183, pl. 1, figs. 9, 12; Silberling *in* Hose and Repenning, 1959: 2194; Jeannet, 1959: 30, pl. 6, fig. 1; Tozer, 1961a: 44, pl. 13, figs. 8, 9; Kummel, 1966: 388, pl. 1, figs. 11, 12; Kummel and Erben, 1968: 112, pl. 19, fig. 9; Kummel, 1968b: 489.

Pseudosageceras intermontanum Hyatt and Smith, 1905: 99, pl. 4, figs. 1–3, pl. 5, figs. 1–6, pl. 63, figs. 1, 2; Mathews, 1929: 3, pl. 1, figs. 18–22; C. Renz, 1945: 301; C. Renz, 1947: 147; Renz and Renz, 1947: 62; Renz and Renz, 1948: 90, pl. 16, figs. 4, 7.

Pseudosageceras multilobatum var. *giganteum* Kiparisova, 1947: 127, pl. 26, figs. 2–5; Popov, 1961: 13, pl. 2, figs. 1, 2.

Pseudosageceras cf. *multilobatum,*—Kiparisova, 1961: 30, fig. 3.

Pseudosageceras schamarense Kiparisova, 1961: 31, pl. 7, figs. 3, 4.

Pseudosageceras cf. *clavisellatum,*—Renz and Renz, 1948: 90, pl. 16, fig. 3.

Pseudosageceras longilobatum Kiparisova and Krishtofovich, 1954: 20, pl. 11, fig. 3; Kiparisova, 1961: 29, pl. 6, figs. 1, 2, text-fig. 2; Popov, 1961: 12, pl. 10, fig. 1, text-fig. 2.

This is without doubt the most common and longest ranging of all Scythian ammonoids. The species *multilobatum* differs from *P. drinense* in the retention of a narrow tabulate venter; however, the sutures are not all that different. Including *Pseudosageceras longilobatum* Kiparisova in this species is done mainly on the claim of Popov (1961, p. 13) that the venter on the holotype of *longilobatum* is not preserved, but on the specimen figured by Popov (1961, pl. 10, fig. 1), which has a suture identical to the holotype of *longilobatum,* the venter is tabulate. The lobes and saddles of this species are not much different from those of *multilobatum* (Fig. 2A, I).

Occurrence. Worldwide in distribution, found in all Scythian zones. From the uppermost Scythian, the species is known from the *Subcolumbites* fauna of Chios; the upper Scythian of the Mangyshlak Peninsula; the Narmia Member of the Mianwali Formation in the Surghar Range and Salt Range of West Pakistan; Nifoekoko, Timor; the *Subcolumbites* fauna of the Primorye Region; the *Olenekites* and *Dieneroceras* zones of the Olenek River region; the *Columbites* fauna of southeast Idaho; the Upper Thaynes Formation, Confusion Range, Nevada; Upper Tobin Formation, south end of Tobin Range, Nevada.

Repository. Specimens from *Columbites* Zone at Montpelier Canyon—suture specimen (Fig. 2C) MCZ 9628, unfigured specimens MCZ 9549; from Hot Springs MCZ 9550; specimens from upper Thaynes Formation, Confusion Range, plesiotype (Pl. 34, fig. 6) USNM 153072; unfigured specimen from Tobin Formation, Nevada, MCZ 9650; from Narmia Member, Mianwali Formation, Salt Range and Surghar Range, West Pakistan, MCZ 9576–9580; from *Subcolumbites* fauna Kotal-e-Tera, Afghanistan, MCZ 10166, 10173; from *Subcolumbites* fauna of Chios, plesiotype *P. intermontanum* (Renz and Renz, 1948: pl. 16, fig. 4) NHMB J13813; (Renz and Renz, 1948: pl. 16, fig. 7) NHMB J13814, unfigured specimens NHMB J13815; *P.* cf. *clavisellatum* (Renz and Renz, 1948: pl. 16, fig. 3) NHMB J13812; specimen from *Olenekites* Zone, Olenek River region MCZ 8678.

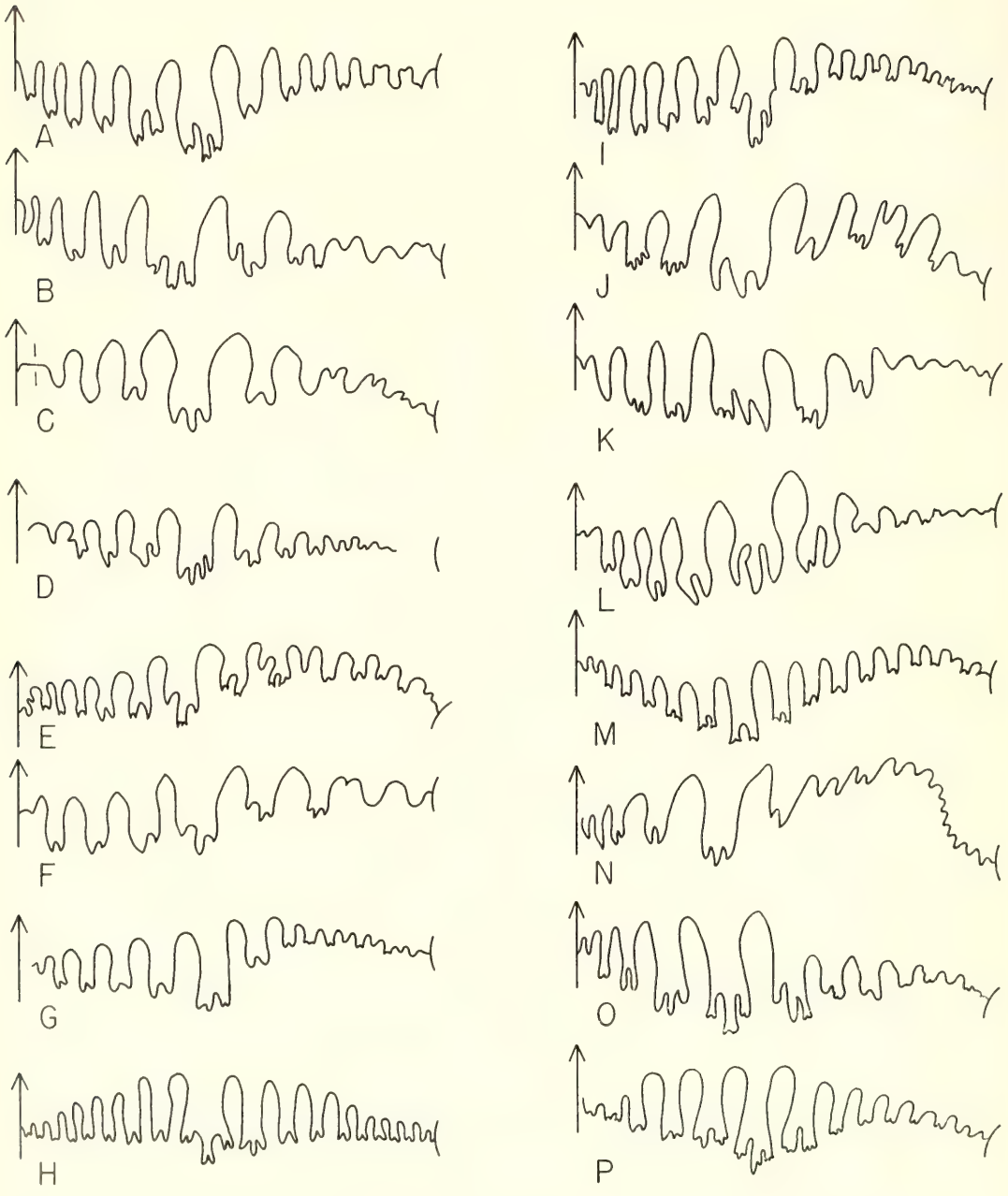


Figure 2. Diagrammatic representation of the suture of: A, *Pseudosageceras multilobatum*,—Krafft and Diener (1909: pl. 21, fig. 5c), from *Hedenstroemia* beds, Muth, Himalayas, at a diameter of approximately 70 mm; B, holotype *Pseudosageceras intermontanum* Hyatt and Smith (1905: pl. 4, fig. 3), from *Meekoceras* limestone, Thaynes Formation, southeast Idaho, at a diameter of 65 mm; C, *Pseudosageceras multilobatum* Noetling (MCZ 9628), from *Columbites* fauna, Montpelier Canyon, southeast Idaho, at a whorl height of 10.5 mm; D, *Pseudosageceras schamarense* Kiparisova (1961: fig. 4), from mid-Scythian strata in the Primorye Region, at a whorl height of 18 mm; E, *Pseudosageceras drinense* Arthaber (1911: pl. 17(1), fig. 7), from *Subcolumbites* fauna of Albania; F, *Pseudosageceras drinense* Arthaber, from Upper Thaynes Formation, Hammond Creek, southeast Idaho (MCZ 9489), at a whorl height of 13 mm; G, *Pseudosageceras simplex*

Pseudosageceras drinense Arthaber
Plate 12, figures 4, 5; Text-figure 2

Pseudosageceras multilobatum,—Arthaber, 1908: 279, pl. 12(2), figs. 3a–c.
Pseudosageceras drinense Arthaber, 1911: 201, pl. 17(1), figs. 6, 7; Diener, 1915: 236; C. Renz, 1928: 155; Kutassy, 1933: 639; Spath, 1934: 55, fig. 6c; Renz and Renz, 1947: 62; Renz and Renz, 1948: 92, pl. 16, figs. 6–6a.
Pseudosageceras drinense Arthaber var. *incentrolata* Renz and Renz, 1948: 92, pl. 16, figs. 11–11a.
Metahedenstroemia n. sp. Kummel, 1954: 187.

Arthaber (1911: 201) stated he had 13 specimens of this species but only the holotype specimen (Pl. 12, figs. 4, 5) is still preserved. The principal distinguishing feature of this species is the acute venter developed in the later growth stages. The suture (Fig. 2E) is quite similar to that of *Pseudosageceras multilobatum*. A small fragmentary specimen from the upper Thaynes Formation can be assigned to this species. Its suture (Fig. 2F), though taken at a whorl height of 13 mm, is like that of the Albanian specimens.

Occurrence. *Subcolumbites* fauna of Albania and Chios; the upper Thaynes Formation, Hammond Creek, southeast Idaho.

Repository. The holotype is in the Paleontological Institute, Vienna; the British Museum has 15 paratypes BMNH C22984–98, C23002; the figured specimens from Chios (Renz and Renz, 1948: pl. 16, fig. 6) NHMB J13816, unfigured specimens from Maradovuno on Chios NHMB J13817, from Kephalovuno NHMB J13818; the specimen from southeast Idaho is MCZ 9489.

Pseudosageceras albanicum (Arthaber)
Plate 21, figures 5, 6; Text-figure 2

Sageceras albanicum Arthaber, 1908: 281, pl. 13(3), figs. 1a–c; Arthaber, 1911: 203, pl. 17(1), figs. 4, 5; Diener, 1915: 249; C. Renz, 1928: 155; Kutassy, 1933: 651; Renz and Renz, 1947: 62; Renz and Renz, 1948: 94, pl. 16, figs. 5–5a, 10–10a.
Pseudosageceras albanicum,—Spath, 1934: 56, fig. 6b.

Arthaber (1911: 203) stated he had 15 specimens of this species. There is today in the Paleontological Institute, Vienna, only the holotype figured by Arthaber and also figured here (Pl. 21, figs. 5, 6). This specimen measures 64.3 mm in diameter, 12 mm for the width of the adoral whorl, and approximately 40 mm for the height of the adoral whorl. Arthaber's representation of the suture (Fig. 2M) is accurate. The principal distinguishing feature of this species is its suture.

Occurrence. *Subcolumbites* fauna of Albania and Chios.

Repository. The holotype is in the Paleontological Institute, Vienna; the British Museum has 13 paratypes BMNH C22999–23001, 23003–12; the plesiotypes from Chios (Renz and Renz, 1948: pl. 16, fig. 5) NHMB J13821, (Renz and Renz, 1948: pl. 16, fig. 10) NHMB J13822; unfigured specimens from Maradovuno NHMB J13823, from Kephalovuno NHMB J13824.

←

Kiparisova (1961: fig. 1), from *Subcolumbites* fauna, Primorye Region, Siberia, at a whorl height of 14.5 mm; H, *Pseudosageceras pasquayi* Renz and Renz (1948: pl. 16, fig. 2b), from *Subcolumbites* fauna of Chios, at a diameter of 35 mm; I, *Pseudosageceras longilobatum* Kiparisova (1961: fig. 2), from *Subcolumbites* fauna of Primorye Region, Siberia, at a whorl height of 19 mm; J, holotype, *Pseudosageceras tsotengense* Chao (1959: fig. 5b), from *Owenites* zone, Kwangsi, China, at a diameter of approximately 30 mm; K, *Pseudosageceras longilobatum* var. *kwangsiense* Chao (1959: fig. 5c), from *Owenites* Zone, Kwangsi, China, at a diameter of approximately 35 mm; L, *Pseudosageceras compressus* (Mathews, 1929: pl. 1, fig. 17), from *Anasibibites* fauna, Fort Douglas, Utah, at a diameter of approximately 20 mm; M, *Pseudosageceras albanicum* (Arthaber, 1911: pl. 17(1), fig. 5), from *Subcolumbites* fauna of Albania at a diameter of 55 mm; N, holotype *Pseudosageceras curvatum* Chao (1959: fig. 52), from *Flemingites* fauna, Kwangsi, China, at a diameter of approximately 70 mm; O, *Pseudosageceras* cf. *clavisellatum*, Renz and Renz (1948: pl. 16, fig. 3a), from *Subcolumbites* fauna of Chios, at a diameter of 24 mm; P, *Pseudosageceras clavisellatum* Diener (1913: pl. 4, fig. 5c), from *Ophiceras* layer, Pastannah, Kashmir, at a diameter of approximately 30 mm.

Pseudosageceras pasquayi Renz and Renz
Text-figure 2

Pseudosageceras (*Metasageceras*) *pasquayi* Renz and Renz, 1947: 62, 79; Renz and Renz, 1948: 93, pl. 16, fig. 2.

Pseudosageceras pasquayi,—Kummel, *in* Arkell et al., 1957: L75.

A species based on a single specimen, distinctive for its unusual suture (Fig. 2H). The holotype measures 37.7 mm in diameter, 6.3 mm for the width of the adoral whorl, 22.5 mm for the height.

Occurrence. *Subcolumbites* fauna, Chios.

Repository. Holotype NHMB J13820.

Pseudosageceras simplex Kiparisova
Text-figure 2

Pseudosageceras simplex Kiparisova, 1947: 128, pl. 25, fig. 2, text-fig. 6; Kiparisova, 1961: 28, pl. 6, fig. 3, text-fig. 1.

Another species established for a single incomplete specimen. Its special features are a narrow rounded venter and a quite simple suture (Fig. 2G). The suture is very much like that of *P. albanicum* except for its lack of curvature (Fig. 2G, M). It is highly possible that this difference is not of specific importance and that additional samples of each of these species would show the curvature and alignment of the suture to be highly variable.

Occurrence. *Subcolumbites* Zone, Primorye Region, Siberia.

Genus *Cordillerites* Hyatt and Smith, 1905
Type species, *Cordillerites angulatus* Hyatt and Smith, 1905

Cordillerites angulatus Hyatt and Smith
Plate 20, figures 5, 6; Plate 51, figures 6, 7; Text-figure 3

Cordillerites angulatus Hyatt and Smith, 1905: 110, pl. 2, figs. 1–8, pl. 68, figs. 1–10, pl. 71, figs. 1–6, pl. 85, figs. 14–20; Frech, 1908: pl. 63, fig. 2; Diener, 1915: 112; Diener, 1917: 175, pl. 1, fig. 11; Smith, 1932: 96, pl. 2, figs. 1–8, pl. 42, figs. 14–20, pl. 60, fig. 14, pl. 68, figs. 1–10, pl. 71, figs. 1–6; Spath, 1934: 61; C. Renz, 1947: 176; Kummel, *in* Arkell, et al., 1957: L75.

Hedenstroemia skipetarensis Arthaber, 1911: 208, pl. 17(1), fig. 13.

Table 23. Measurements of 15 Specimens Assigned to *Cordillerites angulatus* Hyatt and Smith.

	D	W	H	U	W/D	H/D	U/D
1.	97.0	28.0	59.4	0	28.9	61.2	0
2.	42.0	14.0	28.0	0	33.3	66.6	0
3.	35.0	10.0	23.0	0	28.6	65.9	0
4.	35.0	11.0	22.4?	0	31.4	64.0?	0
5.	33.0	6.3?	20.0	0	19.1	60.6	0
6.	29.5	5.8	17.4?	0	19.7	59.0?	0
7.	24.2	6.2	15.6	0	25.6	64.5	0
8.	22.6	5.3	13.7	0	23.5	60.6	0
9.	22.0	4.5?	13.4	0	20.5	60.9	0
10.	21.3	5.3	14.0	0	24.9	65.6	0
11.	19.4	4.7	12.0?	0	24.2	61.9?	0
12.	15.8	4.1	9.4	0	25.9	59.5	0
13.	15.3	4.0	9.4	0	26.1	61.5	0
14.	14.4	4.5	9.3	0	31.1	64.5	0
15.	14.2	3.1	8.0	0	21.8	56.4	0

1. Paralectotype, Hyatt and Smith (1905: pl. 68, figs. 1–3).
2. Holotype, *Pseudosageceras bicarinatum* Tozer (1965: 16).
3. Paralectotype, Hyatt and Smith (1905: pl. 2, figs. 4, 5).
4. Lectotype, Hyatt and Smith (1905: pl. 2, figs. 1–3).
5. Plesiotype (Pl. 51, fig. 1), MCZ 9569.
6, 10, 15. Specimens from *Columbites* fauna, Bear Lake region, southeast Idaho.
7. Paralectotype, Hyatt and Smith (1905: pl. 68, figs. 8–10).
8. Plesiotype,—Renz and Renz (1948: pl. 16, fig. 9).
9, 13. Unfigured specimens from Chios, NHMB.
11. Paralectotype, Hyatt and Smith (1905: pl. 2, fig. 6).
12. Holotype, *Hedenstroemia skipetarensis* Arthaber (1911: pl. 17(1), fig. 13).
14. Paralectotype, Hyatt and Smith (1905: pl. 42, figs. 14–16).

Epihedenstroemia skipetarensis,—Spath, 1934: 222, fig. 71.

cf. *Cordillerites angulatus*,—Renz and Renz, 1947: 67; Renz and Renz, 1948: 88, pl. 16, fig. 9.

Cordillerites kwangsianus Chao, 1959: 33, 188, pl. 44, figs. 7, 8, text-fig. 6b; Kummel and Steele, 1962: 645.

Cordillerites orientalis Chao, 1959: 34, 188, pl. 1, figs. 10, 11, text-fig. 6a.

Pseudosageceras bicarinatum Tozer, 1965a: 16, pl. 2, figs. 8a–d, text-fig. 1.

Cordillerites up until now has been known only through its type species, *C. angulatus*, from the *Meekoceras* limestone of southeast Idaho. The description and illustrations of this species by Hyatt and Smith (1905) and Smith (1932) are quite adequate. The measurements of the specimens assigned to this species are given on Table 23.

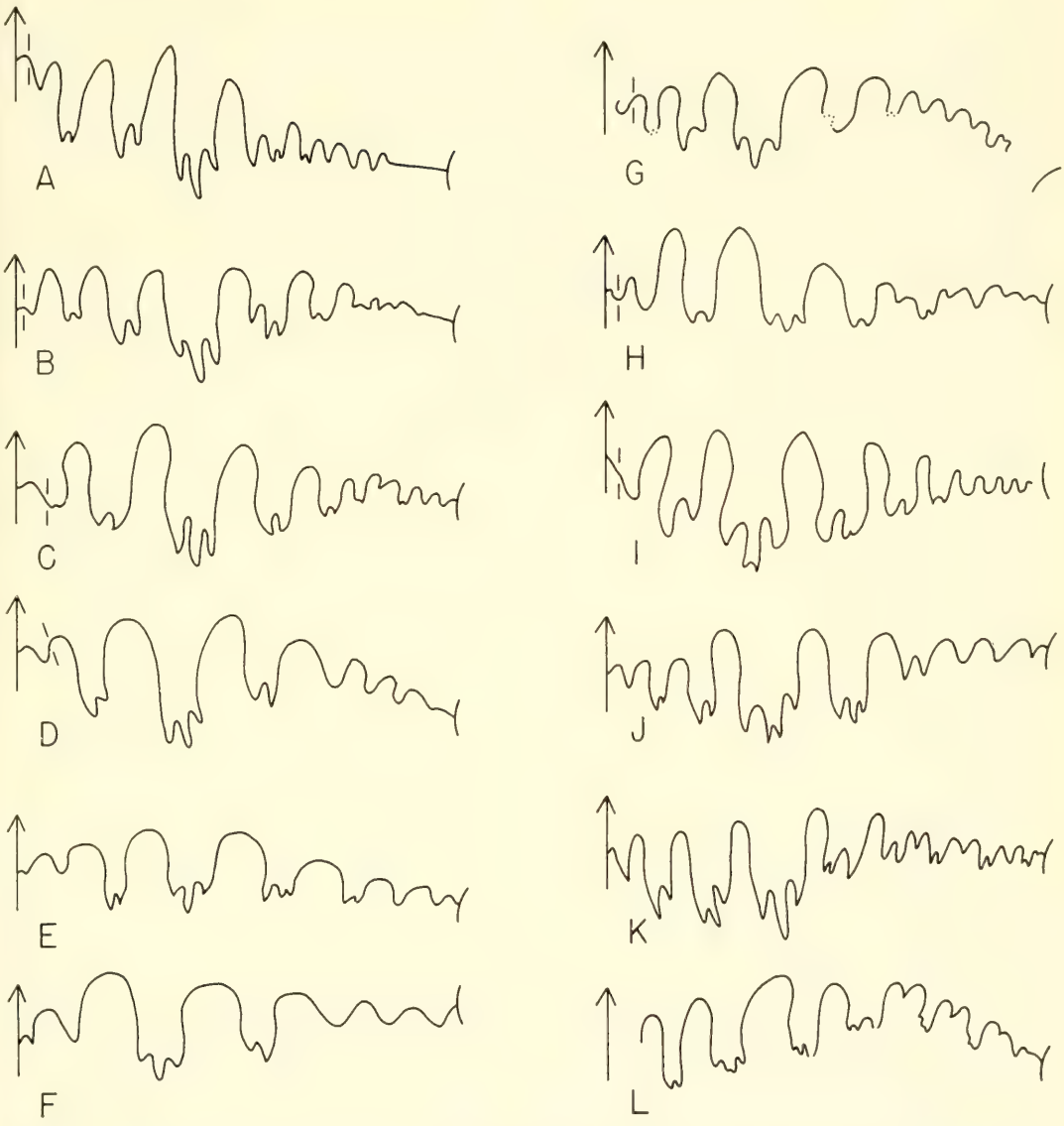


Figure 3. Diagrammatic representation of the sutures of two species of *Cordillerites*. A–K, *Cordillerites angulatus* Hyatt and Smith; A, paralectotype, at a diameter of 90 mm (Hyatt and Smith, 1905: pl. 68, fig. 3, USNM 75300a); B, paralectotype, at a diameter of 80 mm (Hyatt and Smith, 1905: pl. 68, fig. 6, USNM 75300b); C, lectotype, at a diameter of 35 mm (Hyatt and Smith, 1905: pl. 2, fig. 3, USNM 75247a); D, paralectotype, at a diameter of 25 mm (Hyatt and Smith, 1905: pl. 68, fig. 10, USNM 75300c); E, paralectotype, at a diameter of 17 mm (Hyatt and Smith, 1905: pl. 71, fig. 5); F, paralectotype, at a diameter of 10 mm (Hyatt and Smith, 1905: pl. 71, fig. 2); G, holotype of *Hedenstroemia skipetarensis* Arthaber (1911: pl. 17(1), fig. 13), new drawing at a diameter of 15.7 mm; H, specimen from *Columbites* Zone, southeast Idaho, at a diameter of 29 mm (MCZ 9569); I, cf. *Cordillerites angulatus*,—Renz and Renz (1948: pl. 16, fig. 9b), at a diameter of approximately 20 mm; J, holotype *C. orientalis* Chao (1959: fig. 6a), at a diameter of 55 mm; K, holotype *C. kwangsianus* Chao (1959: fig. 6b), at a diameter of 19 mm; L, *Cordillerites concinnus* Kiparisova (1961: fig. 5), at a diameter of 42 mm.

Specimens of figures A–F, from *Meekoceras* fauna of southeastern Idaho; G, from *Subcolumbites* fauna of Albania; H, *Columbites* fauna of southeastern Idaho; I, from *Subcolumbites* fauna of Chios; J, from *Subcolumbites* fauna of Kwangsi, China; K, from *Owenites* fauna of Kwangsi, China; L, from the *Proptychites* Zone of the Primorye Region.

The *Columbites* fauna of southeast Idaho has yielded six specimens of this species. One of them is illustrated here on Plate 51, figures 6, 7 and its suture on Figure 3H. These specimens agree remarkably with all the essential features of the types from the *Meekoceras* limestone.

Hedenstroemia skipetarensis Arthaber (1911: 208) was established for a small, involute, compressed specimen of 15.8 mm in diameter (Pl. 20, figs. 5, 6). Arthaber (1911) considered this small specimen to be unique and possibly deserving separate generic status. Spath (1934: 222) established the genus *Epihedenstroemia* with *Hedenstroemia skipetarensis* Arthaber as type. The uniqueness of the species centers around the curvature of the suture as depicted by Arthaber (1911: pl. 17(1), fig. 13c). Re-examination of Arthaber's type specimen clearly shows that this representation of the suture was not one of the most successful in his monograph. A new drawing of the suture of this type specimen is shown here on Figure 3G. The suture is nearly identical to the suture of the American specimens of *Cordillerites angulatus* from the *Meekoceras* limestone at a diameter of 17 mm (Fig. 3E) and 25 mm (Fig. 3D). The shape of the conch, nature of the venter, etc., also fit in perfectly with the American type specimens. The *Subcolumbites* fauna of Chios also contains this species. Renz and Renz (1948: 89) had one specimen they assigned to this species with the symbol "cf." There are in addition four specimens from the *Subcolumbites* fauna of Chios in the Natural History Museum, Basel. The suture (Fig. 3I), as noted by Renz and Renz (1948: 89), is very much like that of the lectotype (Fig. 3C). There is no question but that these *Subcolumbites* fauna specimens from Chios are conspecific with the American type specimens.

Tozer (1965a: 16), in the discussion of his new species *Pseudosageceras bicarinatum*, stressed the possible affinities of his species with *Hedenstroemia skipetarensis* Arthaber. The suture of Tozer's specimen is nearly identical to that of *C. angulatus* illustrated by Hyatt and Smith (1905: pl. 68, fig. 6; Fig. 3B of this report). The general shape of the conch, etc., fits in perfectly.

The descriptions and illustrations of *Cordillerites kwangsianus* Chao (1959) from the *Owenites* Zone, Kwangsi, China, and *Cordillerites orientalis* from the *Subcolumbites* fauna of Kwangsi, China, leave much to be desired. The first of these species was based on a single specimen, the second on only two. The sutures of these species (Figs. 3J, K) are very comparable to the mature sutures of the American type specimens (Figs. 3A, B). I can find no justification for not considering these two species as synonyms of *Cordillerites angulatus*.

The only other species of *Cordillerites* recognized here is *C. concinnus* Kiparisova from the early Scythian *Proptychites* Zone of Kiparisova (1961: 33) in the Primorye Region, Siberia. This species differs mainly in the nature of its suture.

Cordillerites compressus Mathews (1929: 3) from the *Anasibirites* fauna of Fort Douglas, Utah, had been accepted as a valid species of *Cordillerites* by Smith (1932) and Spath (1934). On the basis primarily of the much greater elaboration of the suture, I consider this to be a species of *Pseudosageceras*.

Occurrence. This species is now known from the mid-Scythian *Meekoceras* Zone of southeast Idaho and the equivalent horizon in Kwangsi, China (Chao collection 542b); from the *Columbites* fauna of southeast Idaho; from the *Subcolumbites* fauna (or its equivalent) in Albania, Chios, Kwangsi, and British Columbia.

Repository. The new specimens from the *Columbites* fauna of southeast Idaho recorded here are MCZ 9569 (Pl. 51, figs. 5, 6), unfigured specimens from Hot Springs MCZ 9627.

Order CERATITIDA Hyatt, 1884
Superfamily OTOCERATACEAE Hyatt, 1900
Family DIENEROCERATIDAE Kummel, 1952

This family was originally introduced for the single genus *Dieneroceras* which is interpreted as a persisiting stock of the ophiceratids and a probable root of later ornamented stocks. *Dieneroceras* is one of the simplest of Scythian ammonoids and quite common throughout the Scythian. Included in the family are *Subvishnuites* and *Hemilecanites*. Both of these genera are much like *Dieneroceras* in the simplicity of their sutures and conch form. They are characterized by acute venters; *Subvishnuites* has a more inflated whorl section; *Hemilecanites* a highly compressed whorl section. *Hemilecanites* is restricted to the late Scythian *Prohungarites* Zone; *Dieneroceras* and *Subvishnuites* are quite common in mid-Scythian faunas.

Genus *Dieneroceras* Spath, 1934
Type species, *Ophiceras dieneri* Hyatt and Smith, 1905

This genus is not nearly as common nor as widely distributed in the late Scythian as it is in the Owenites Zone of mid-Scythian age. There are two species (*D. mediterranea, D. skutarensis*) represented by few specimens in the *Subcolumbites* faunas of Albania and Chios. The correlative fauna in the Primorye Region contains a single specimen assigned to *D. karazini* n. sp. In the underlying *Columbites* Zone there are only two species: *D. demokidovi* from northern Siberia, and *D. apostolicus* from southeast Idaho and northern Siberia.

Dieneroceras mediterranea (Arthaber)
Plate 4, figures 7–10; Plate 19, figures 3, 4; Text-figure 4.

Xenaspis mediterranea Arthaber, 1908: 260, pl. 11(1), figs. 3a–c; Arthaber, 1911: 231; Diener, 1915: 311; Spath, 1934: 134, 136, 293.
Celtites kcirensis Arthaber, 1908: 273, pl. 11(1), figs. 8a–c; Diener, 1915: 75; Renz and Renz, 1948: 42, pl. 3, fig. 6 (non 3).
Xenodiscus kcirensis (Arthaber) 1911: 181.
Ophiceras sakuntala Arthaber (non Diener), 1911: 239, pl. 21(5), fig. 4.
Ophiceras cf. *sakuntala* Diener, 1915: 212.

The type specimen measures 53.7 mm in diameter, 11.4 mm for the width of the last whorl, 13.8 mm for the height, and 26.5 mm for the diameter of the umbilicus. The whorls are subtrapezoidal in cross-section, the flanks converging slightly towards a low, arched venter. The ventral and umbilical shoulders are rounded. The specimen had been ground and polished on part of the phragmocone to expose the suture, but in this case I do not believe there is any appreciable distortion to the suture. A new drawing of this suture is shown on Figure 4A.

The specimen Arthaber (1908: 273) assigned to *Celtites kcirensis* is a small individual with the following measurements: Diameter 28.8, Width 8.8, Height 9.3, Umbilicus 12.8 mm. The apparent sharpening of the venter in the adoral quarter volution I believe is due to factors of preservation and is not the true outline of the whorl at that stage (Pl. 4, figs. 9, 10). The suture is identical to that of the type specimen. The specimen clearly is a juvenile form of *D. mediterranea*. A comparable specimen from the *Subcolumbites* fauna of Chios was assigned by Renz and Renz (1948: 42, pl. 3, fig. 6) to *Celtites kcirensis*, and this I believe also to be a juvenile form of *D. mediterranea*. One of the specimens from Chios that Renz and Renz (1948: 42, pl. 3, fig. 3) assigned to *Celtites kcirensis* is a specimen of *Hemilecanites discus*.

The specimen Arthaber assigned to *Ophiceras sakuntala* Diener is incomplete and slightly crushed (Pl. 19, figs. 3, 4). Direct comparison of this specimen with the other specimens assigned to *D. mediterranea* convinces me that they are conspecific.

Occurrence. *Subcolumbites* fauna of Albania and Chios.

Repository. The Paleontological Institute of Vienna has the holotype of *Xenaspis*

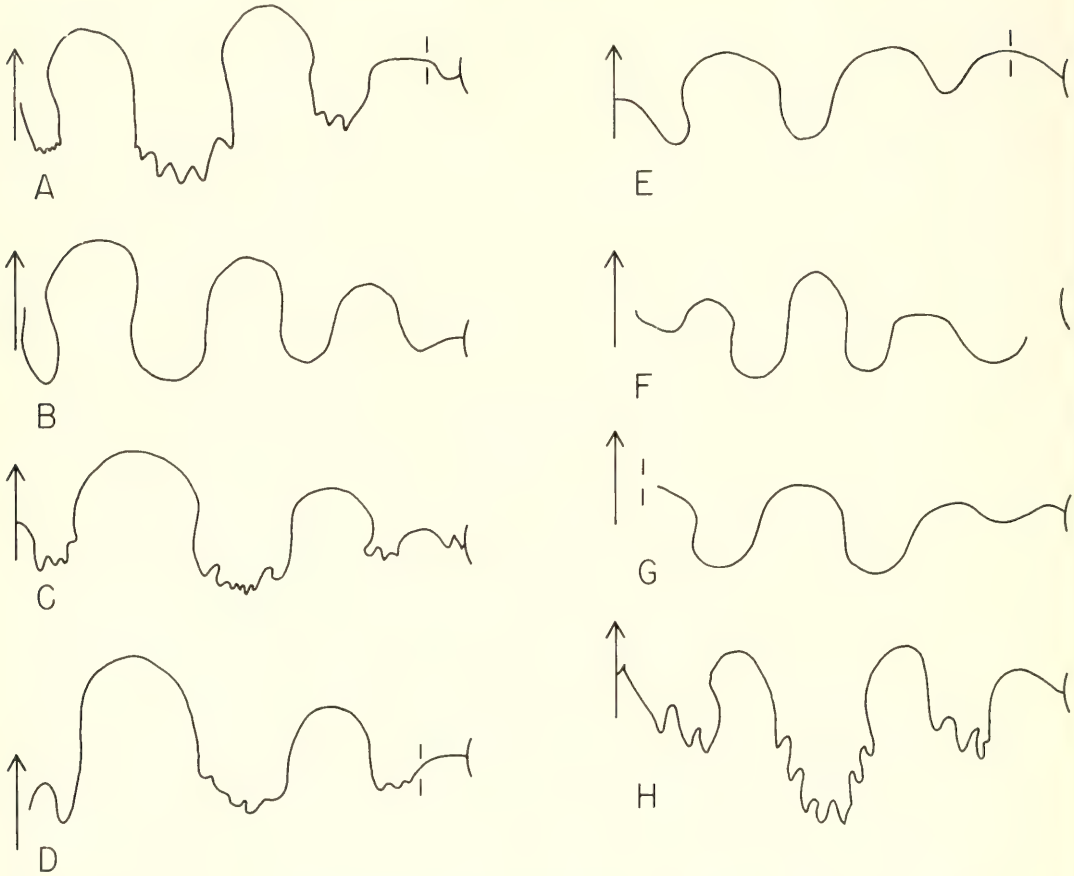


Figure 4. Diagrammatic representation of the suture of: A, holotype, *Dieneroceras mediterranea* (Arthaber, 1908: pl. 11(1), figs. 3a–c), from *Subcolumbites* fauna of Albania, new drawing at a diameter of 36 mm; B, holotype *Dieneroceras skutarensis* (Arthaber, 1911: pl. 21(5), fig. 1), from *Subcolumbites* fauna of Albania, at a diameter of 18 mm; the goniatitic aspect of the lobes is most probably due to excessive grinding in the preparation of the specimen; C, *Dieneroceras demokidovi* Popov (1961: fig. 6f), from "*Dieneroceras*" Zone, Olenek River basin, Siberia; D, *Dieneroceras karazini* nov. nom. (Kiparisova, 1961: fig. 14), from *Subcolumbites* fauna, Primorye Region, Siberia, at a whorl height of 7 mm; E, holotype *Hemilecanites discus* (Arthaber, 1908: pl. 11(1), fig. 5), from *Subcolumbites* fauna of Albania at a diameter of approximately 20 mm; F, paratype *Hemilecanites paradiscus* n. sp. from *Subcolumbites* fauna of Tobin Formation, Nevada, at a diameter of 16 mm (MCZ 9631); G, paratype *Hemilecanites paradiscus* n. sp. from *Subcolumbites* fauna of Tobin Formation, Nevada, at a diameter of 14 mm (MCZ 9483); H, holotype *Xenaspis enveris* Arthaber (1911: pl. 20(4), fig. 3), from *Subcolumbites* fauna of Albania.

mediterranea and *Celtites kcirensis*, and the plesiotype of *Ophiceras sakuntala* Arthaber (non Diener). The plesiotype of *Celtites kcirensis* from Chios is NHMB J13654.

Dieneroceras skutarensis (Arthaber)

Plate 20, figures 3, 4; Text-figure 4

Lecanites skutarensis Arthaber, 1911: 237, pl. 21(5), fig. 1; Spath, 1934: 135, 136; Renz and Renz, 1947: 61; Renz and Renz, 1948: 55, pl. 3, fig. 5.

Proavites skutarensis,—Diener, 1915: 228.

This is a dieneroceratid very much on the pattern of *Dieneroceras knechti* (Hyatt and Smith) from the *Owenites* Zone; it could possibly be conspecific with that species. However, because of the smallness of the sample available, a tendency for *D. sku-*

tarensis to have a slightly more inflated whorl section, and the great age difference between these forms I believe it best to recognize the independent status of this species. Another factor is the goniatitic character of the lobes (Fig. 4B). The specimen has been excessively ground and polished to expose the suture, and this could entirely account for the smooth lobes.

Occurrence. *Subcolumbites* fauna of Albania and Chios.

Repository. The holotype, and only specimen from Albania, is in the Paleontological Institute, Vienna. The figured specimen from Chios (Renz and Renz, 1948: pl. 3, fig. 5) is NHMB J13700, unfigured specimens from Maradovuno NHMB J13701, from Kephalovuno NHMB J13702. The MCZ has three specimens from Chios, MCZ 10027, 10029.

Dieneroceras karazini n. sp.
Text-figure 4

Dieneroceras dieneri Kiparisova (non Hyatt and Smith) 1961: 47, pl. 9, fig. 2.

Kiparisova had only a single specimen of this species and this is indeed quite similar to *D. dieneri.* However, because of the great difference in age of the American *D. dieneri* (*Owenites* fauna) and the Primorye specimen (*Subcolumbites* fauna) I believe it best to consider them as separate species. There are differences in involution, shape of the whorl section and suture (Fig. 4D), but the smallness of the sample prevents any evaluation of these differences.

Occurrence. Primorye Region, from *Subcolumbites* fauna between Cape Mushketov and Cape Karazin.

Dieneroceras demokidovi Popov
Text-figure 4

Dieneroceras demokidovi Popov, 1961: 36, pl. 12, figs. 1, 5.
Dieneroceras nikabitensis Popov, 1962a: 184, pl. 3, fig. 1.

The conch of this species is very much on the pattern of that of *D. knechti* from the *Owenites* Zone, except that the whorls are slightly more inflated. The conch is apparently completely smooth. It is really only in the smoothness of the conch that one can readily separate this species from *D. apostolicus.* The suture is illustrated on Figure 4C.

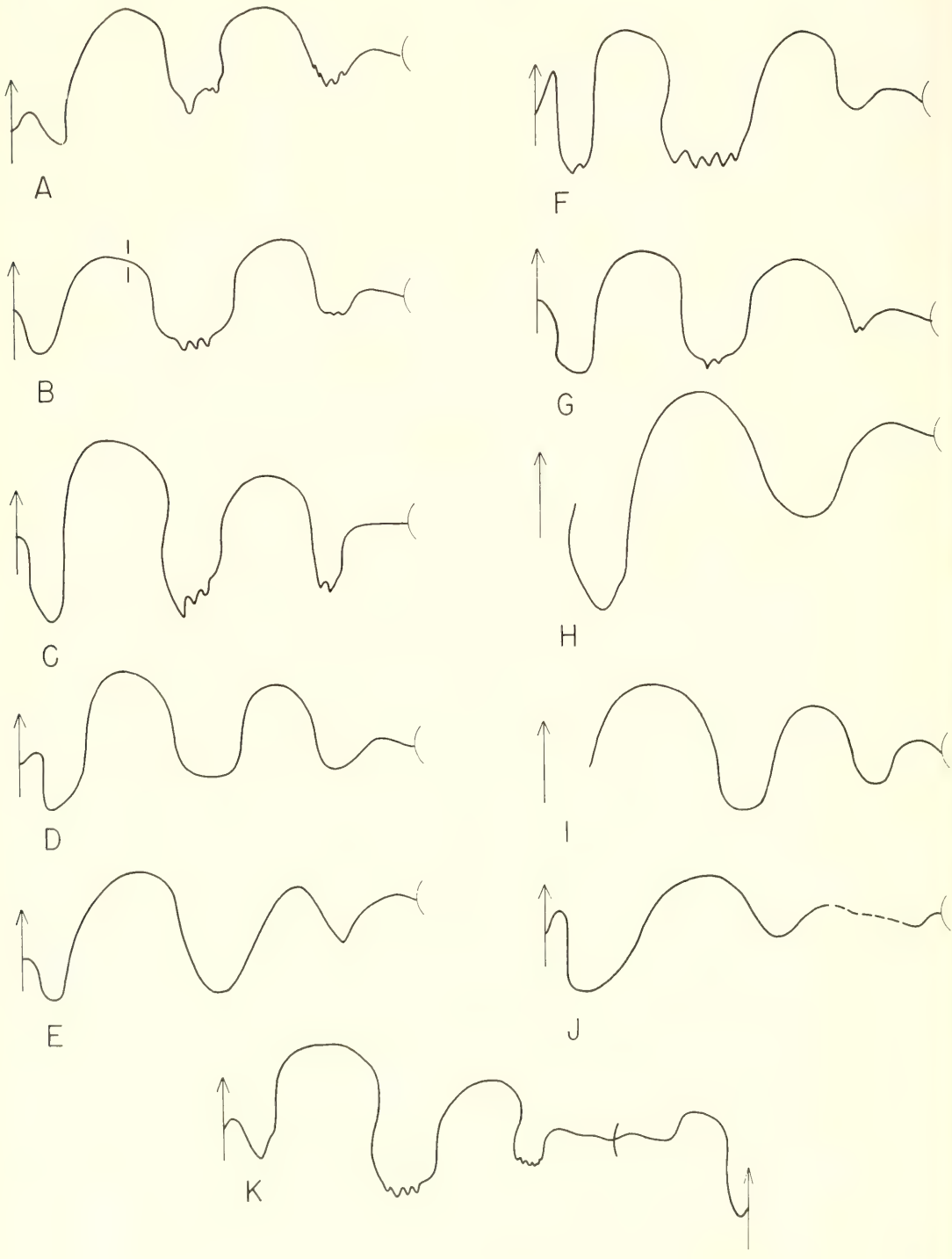
Occurrence. *Dieneroceras* Zone of Popov (1961) from a number of localities in the Olenek and Kolyma river basins, Siberia.

Repository. Popov's specimens are in the Tchernyshev Central Geological Museum of Leningrad. The Museum of Comparative Zoology has three topotype specimens, MCZ 6105, 6106, 8679.

Dieneroceras apostolicus (Smith)
Plate 53, figures 1–12; Text-figures 5, 6

Celtites apostolicus Smith, 1932: 104, pl. 48, figs. 1–10.
"Celtites" apostolicus,—Kummel, 1954: 187; Kummel, 1961: 519.
Dieneroceras apostolicus,—Popov, 1961: 37, pl. 12, fig. 6.
Celtites planovolvis Smith, 1932: 104, pl. 48, figs. 11–20.
"Celtites" planovolvis,—Kummel, 1954: 181; Kummel, 1961: 519.
Celtites ursensis Smith, 1932: 104, pl. 47, figs. 11–23.
"Celtites" ursensis,—Kummel, 1954: 187; Kummel, 1961: 519.
Dieneroceras khelaliensis Popov, 1961: 37, pl. 12, fig. 4.

Smith's (1932) analysis and description of his three species of *Celtites* were not the most successful of his efforts. The three species were differentiated on slight differences in height and width of the whorls. The measurements of 50 specimens from the *Columbites* fauna of southeastern Idaho are listed on Table 24 and plotted on Figure 6. It can readily be seen that the umbilical diameter and whorl height show only a small range of variability, clearly intraspecific. Smith (1932: 104) likewise stated the suture to be goniatitic. The sutures of six specimens plus five sutures reproduced by Smith (1932) are shown on Figure 5.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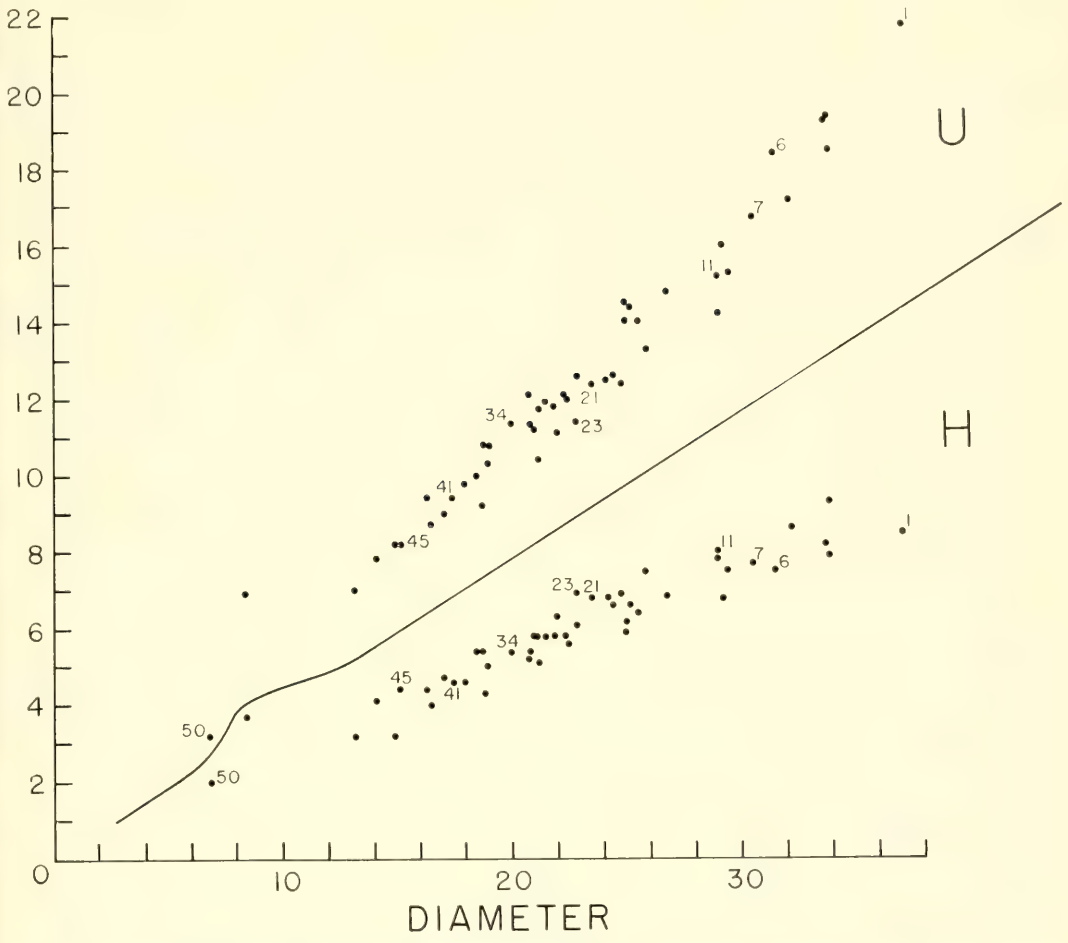

Figure 6. Variation in umbilical diameter (U) and whorl height (H) of *Dieneroceras apostolicus* (Smith) from *Columbites* fauna of Bear Lake region, southeast Idaho. The data on this graph are from Table 24.

All the specimens I studied have denticulated lobes. It should be remarked, however, that the preservation in dense, fine grained, black limestone often makes fine details of the suture very hard to observe. One additional factor of the suture is the great variability in the shape and size of the various elements.

Smith noted the weak, forward projecting constrictions; however, these are absent

←

Figure 5. Diagrammatic representation of the sutures of *Dieneroceras apostolicus* (Smith). A, at a diameter of 14.2 mm (MCZ 9524); B, at a diameter of 16.3 mm (MCZ 9525); C, at a diameter of 24.1 mm (MCZ 9526); D, at a diameter of 18 mm (USNM 74989c), from Smith (1932: pl. 48, fig. 7); E, at a diameter of 7 mm (USNM 74989d), from Smith (1932: pl. 48, fig. 10); F, at a diameter of 20.9 mm (MCZ 9527); G, at a diameter of 15 mm (MCZ 9528); H, at a diameter of 5.5 mm (USNM 74987e), from Smith (1932: pl. 47, fig. 23); I, at a diameter of approximately 22 mm (USNM 74987c), from Smith (1932: pl. 47, fig. 17); J, at a diameter of 15 mm (USNM 74988c), from Smith (1932: pl. 48, fig. 16); K, at a whorl height of 5.2 mm (MCZ 9529). All specimens from *Columbites* fauna, Thaynes Formation of southeast Idaho; specimens A, C, F, K from Montpelier Canyon; B, G, from Hot Springs; D, E, H, I, J from Paris Canyon.

Table 24. Measurements of *Dieneroceras apostolicus* (Smith) from *Columbites* Fauna Around North End of Bear Lake, Southeast Idaho.

No.	D	W	H	U	W/D	H/D	U/D	No.	D	W	H	U	W/D	H/D	U/D
1.	37.0?	9.2	8.5	21.8	24.9?	22.9	58.9	26.	22.0	7.7	6.3	11.1	35.0	28.6	50.5
2.	33.8	8.1	9.3	18.5	23.9	27.5	54.7	27.	21.8	5.0	5.8	11.8	22.9	26.6	54.1
3.	33.7	7.9	7.9	19.4	25.4	25.4	57.5	28.	21.4	6.3	5.8	11.9	39.4	27.1	56.2
4.	33.6	7.5	8.2	19.3	27.3	24.4	57.5	29.	21.2	7.1	5.1	11.7	33.5	24.0	55.2
5.	32.2	?	8.6	17.2	—	26.7	53.5	30.	21.1	5.8	5.8	10.4	27.5	27.5	49.3
6.	31.5	7.9	7.5	18.4	25.1	23.8	58.4	31.	21.0	5.2	5.8	11.2	24.8	27.6	53.4
7.	30.5	8.7	7.7	16.7	28.5	25.2	21.9	32.	20.8	5.7	5.4	11.3	27.4	25.9	54.3
8.	29.4	6.8	7.5	15.3	23.1	25.5	52.0	33.	20.7	6.1	5.2	12.1	38.4	25.1	58.5
9.	29.2	6.8	6.8	16.0	23.3	23.3	54.8	34.	20.0	8.3	5.4	11.4	41.5	27.0	57.0
10.	29.0	6.6	7.8	14.2	22.7	26.8	49.0	35.	19.0	5.5	5.0	10.8	28.9	26.3	56.9
11.	29.0	8.4	8.0	15.2	28.9	27.6	52.4	36.	19.0	7.4	5.0	10.3	38.9	36.3	54.2
12.	26.7	7.0	6.8	14.8	26.2	25.4	57.6	37.	18.8	7.0	4.3	10.8	37.2	22.8	57.5
13.	25.8	6.0	7.5	13.3	23.2	29.0	51.6	38.	18.7	5.7	5.4	9.2	30.5	28.9	49.1
14.	25.5	6.3	6.4	14.0	24.7	27.2	54.9	39.	18.5	6.4	5.4	10.0	34.6	29.2	54.0
15.	25.2?	7.7	6.6	14.4	30.5	25.2	57.2	40.	18.0	5.0	4.6	9.8	27.7	25.5	54.4
16.	25.0	?	6.2	14.0	—	24.8	56.0	41.	17.5	5.5	4.6	9.4	31.4	26.3	53.7
17.	25.0	6.5	5.9	14.5	26.0	23.6	58.0	42.	17.1	5.3	4.7	9.0	31.0	27.5	52.5
18.	24.7	7.5	6.9	12.4	31.6	24.3	50.2	43.	16.5	4.6	4.0	8.7	27.8	24.2	54.3
19.	24.4	6.1	6.6	12.6	25.0	27.1	51.7	44.	16.3	5.0	4.4	9.4	30.6	27.0	57.7
20.	24.2	7.0	6.8	12.5	28.9	28.1	51.6	45.	15.2	5.5	4.4	8.2	36.2	28.9	53.9
21.	23.5	8.8	6.8	12.4	37.4	28.9	52.8	46.	14.9	5.8	3.2	8.2	38.9	21.4	55.0
22.	22.8	5.8	6.1	12.6	25.4	26.7	55.3	47.	14.1	6.5	4.1	7.8	46.1	29.0	55.3
23.	22.7	6.5	6.9	11.4	28.6	30.4	50.2	48.	13.2	5.6	3.2	7.0	42.4	24.2	53.0
24.	22.4	?	5.6	12.0	—	25.0	53.7	49.	8.4	4.6	3.7	6.9	54.8	44.1	82.2
25.	22.3	5.8	5.8	12.1	26.0	26.0	54.3	50.	6.9	3.8	2.0?	3.2	55.1	28.9?	46.4

1. Paratype, *Celtites ursensis* Smith (1932: pl. 47, figs. 13, 14), USNM 74987b.
6. Holotype (Smith, 1932: pl. 48, figs. 1, 2), USNM 74989a.
7. Holotype, *Celtites ursensis* Smith (1932: pl. 47, figs. 11, 12), USNM 74987a.
11. Paratype, *Celtites ursensis* Smith (1932: pl. 47, figs. 15, 16), USNM 74987c.
21. Holotype, *Celtites planovolvis* Smith (1932: pl. 48, figs. 11, 12), USNM 74988a.
23. Paratype (Smith, 1932: pl. 48, figs. 3, 4), USNM 74989b.
34. Paratype, *Celtites planovolvis* Smith (1932: pl. 48, figs.13, 14), USNM 74988b.
41. Paratype (Smith, 1932: pl. 48, figs. 5–7), USNM 74989c.
45. Paratype, *Celtites ursensis* Smith (1932: pl. 47, figs. 18, 19), USNM 74987d.
50. Paratype (Smith, 1932: pl. 48, figs. 8–10), USNM 74987d.

completely on a large number of specimens, and it is quite clear that this is a highly variable feature. This feature would generally suggest relationship to *Xenoceltites*; however, in this case the whole aspect of the whorls is different from that of "typical" xenoceltitids.

Even though the descriptions and illustrations of Popov's two Siberian species leave much to be desired, I believe they are conspecific with the Idaho forms.

This species is quite similar in its basic conch shape to *D. demokidovi* Popov, but that species apparently is smooth, lacking any form of constrictions.

Occurrence. The middle shale member of the Thaynes Formation, *Columbites* fauna, Paris Canyon, Montpelier Canyon, Hot Springs, and Draney Creek, southeastern Idaho. The two species recorded by Popov are from the *Dieneroceras* Zone of Popov in three different localities in the Kolyma River basin, Siberia.

Repository. Holotype USNM 74989a (Pl. 53, figs. 10, 11); paratypes USNM 74989b (Pl. 53, fig. 12), USNM 74989c (Smith, 1932: pl. 48, figs. 5–7), USNM 74989d (Smith, 1932: pl. 48, figs. 8–10); suture specimens MCZ 9524 (Fig. 5A), MCZ 9525 (Fig. 5B), MCZ 9526 (Fig. 5C), MCZ 9527

(Fig. 5F), MCZ 9528 (Fig. 5G), MCZ 9529 (Fig. 5K); unfigured specimens from Montpelier Canyon MCZ 9530, from Hot Springs MCZ 9531. Holotype *Celtites planovolvis*, USNM 74988a (Pl. 53, figs. 7, 8); paratype USNM 74988b (Pl. 53, fig. 9); suture specimens USNM 74988c (Smith, 1932: pl. 48, fig. 16), USNM 74988d (Smith, 1932: pl. 48, figs. 17–20). Holotype *Celtites ursensis*, USNM 74987a (Pl. 53, figs. 1, 2); paratypes USNM 74987b (Pl. 53, figs. 3, 4), USNM 74987c (Pl. 53, figs. 5, 6), USNM 74987d (Smith, 1932: pl. 47, figs. 18–20), USNM 74987e (Smith, 1932: pl. 47, figs. 21–23).

Genus *Subvishnuites* Spath, 1930
Type species, *Subvishnuites welteri* Spath, 1930 (= *Vishnuites* sp. Welter, 1922)

Records on this genus have increased considerably in recent years. The type species of *Subvishnuites* was based on a single specimen from the *Owenites* fauna of Timor. Conspecific forms have been described by Kummel (1959: 443) from an *Owenites* fauna of South Island, New Zealand, by Popov (1962b: 43—as *Parinyoites mastykensis*) from an *Owenites* fauna of the Caucasus Mountains, and from an *Owenites* fauna of Afghanistan (Kummel and Erben, 1968). In addition, the *Owenites* Zone of Kwangsi, China, contains *Subvishnuites tientungensis* Chao (1959). The specimen from the *Dieneroceras* Zone of Siberia (Popov 1962a) described as *Inyoites eiekitensis* is a species of this genus. The *Columbites* Zone of southeast Idaho has yielded one fragmentary specimen that is described here. This specimen is quite like the Siberian *S. eiekitensis*. Finally, the Narmia Member of the Mianwali Formation in the Trans-Indus Surghar Range, West Pakistan, has yielded fragmentary representatives of this genus described as S. sp. indet. (Kummel, 1966). This horizon contains *Procarnites kokeni*, *Prohungarites* cf. *crasseplicatus*, etc., and is late Scythian in age. *Xenaspis enveris* Arthaber (1911) from the *Subcolumbites* fauna of Albania is considered here to be a species of *Subvishnuites*. The *Subcolumbites* fauna at Kotal-e-Tera, Afghanistan, has also yielded a couple of small specimens that have been recorded as *Subvishnuites* sp. indet. (Kummel, 1968a). There is also an interesting allied species described as *Subvishnuites* cf. *enveris* (Kummel, 1968b) from the *Subcolumbites* fauna of Kotal-e-Tera, Afghanistan.

This genus thus ranges in age through the whole of the upper half of the Scythian. As yet few specimens have been recovered and few species described.

Subvishnuites enveris (Arthaber)
Text-figure 4

Xenaspis enveris Arthaber, 1911: 230, pl. 20(4), fig. 3; Diener, 1915: 311; Spath, 1934: 293.

The type and only specimen of this species is not in the collection of the Paleontological Institute, Vienna. The relationships of this species and its assignment to *Subvishnuites* are discussed fully below in the description of *Subvishnuites* cf. *enveris* from Afghanistan. Spath (1934: 293) considered this species to have a relationship to *Eophyllites*, but this I find difficult to understand.

Occurrence. *Subcolumbites* fauna, Kčira, Albania.

Repository. The specimen is apparently lost, as it is not in the Paleontological Institute, Vienna.

Subvishnuites cf. *enveris* (Arthaber)

Subvishnuites cf. *enveris* (Arthaber), Kummel, 1968b: 491, pl. 1, figs. 8, 9.

This is a most interesting specimen from a *Subcolumbites* fauna at Kotal-e-Tera, Afghanistan. The specimen measures 45 mm in diameter, approximately 20 mm for the width of the adoral whorl, 21 mm for the height, and 11.7 mm for the width of the umbilicus. The whorl sides are broadly arched, converging on to a rounded venter. The whorl sides bear widely spaced radial ribs that commence and are most conspicuous on the umbilical shoulder and decrease in intensity toward the venter

which is smooth. The adoral half volution has four such ribs. The ribs are also present on the inner whorls as far as they are preserved. The umbilical shoulder is abruptly rounded and the umbilical wall, nearly vertical. The suture is not preserved.

Arthaber's specimen of *Xenaspis enveris* is slightly more evolute than my Afghan specimen (34 percent versus 27 percent) and has an acute venter on the adoral part of the living chamber. The ribbing, according to Arthaber, is developed only on the living chamber. The absence of the ribs on the phragmocone could well be a matter of preparation or preservation. The suture of the Albanian specimen consists of two denticulated lateral lobes (Arthaber, 1911: pl. 20(4), fig. 3c).

It appears quite probable that the Albanian *Xenaspis enveris* is not conspecific with this Afghan specimen, though they are most probably congeneric. However, the assignment of these two specimens may be open to question. The type specimen of *Subvishnuites* is a smooth form with an acute venter as are all the other specimens assigned to this genus. The Albanian and Afghan specimens have prominent radial ribs. A case could be made that the Albanian and Afghan species are generically distinct from the more typical species of *Subvishnuites*. However, data are so incomplete on both the Albanian and Afghan species that it would be imprudent to establish a new genus with either of these specimens as type. Because of these factors, and because there are no other late Scythian genera to which these specimens have any similarity, it seems best to assign them to *Subvishnuites*.

Occurrence. *Subcolumbites* fauna, Kotal-e-Tera, Afghanistan.

Repository. MCZ 10148.

Subvishnuites eiekitensis (Popov)

Inyoites eiekitensis Popov, 1962a: 184, pl. 3, fig. 5, text-fig. 6.

The description and illustration of this species leave much to be desired; even so, the whole appearance of the conch and the plan of the suture show this species to be a member of *Subvishnuites*. This species is very similar in general appearance to *Subvishnuites* sp. indet. from the *Columbites* Zone of southeast Idaho. However, that species is known only from a single fragmentary specimen, and data are insufficient to evaluate the relationships of the two forms.

Occurrence. *Dieneroceras* Zone of Popov (1961, 1962a), Lena and Olenek river basins, Siberia.

Subvishnuites sp. indet.
Plate 53, figure 15

A single fragmentary specimen of approximately 34 mm in diameter. The whorls are compressed, convex, converging on an acute venter. The lateral areas bear weak, broad, radial folds which are more apparent on the cast than they are on the shell. The umbilical shoulders are broadly rounded. The suture is only vaguely visible but it does show two lateral lobes.

This specimen is very similar in its form, etc., to *S. eiekitensis* (Popov) from the *Dieneroceras* Zone of Siberia. It could well be conspecific with that species but data are not sufficient to allow a detailed analysis.

Occurrence. *Columbites* Zone, Thaynes Formation, Montpelier Canyon, southeast Idaho.

Repository. MCZ 9512.

Genus *Hemilecanites* Spath, 1934
Type species, *Lecanites discus* Arthaber, 1908

Hemilecanites discus (Arthaber)
Plate 25, figures 9, 10; Text-figure 4

Lecanites discus Arthaber, 1908: 268, pl. 11(1), figs. 5a–c; Arthaber, 1911: 181, 238; Renz and Renz, 1947: 61; Renz and Renz, 1948: 55.

Proavites discus,—Diener, 1915: 228.

Hemilecanites discus,—Spath, 1934: 135, pl. 13, figs. 7a–d; Kummel, *in* Arkell et al., 1957: L136, figs. 169, 3; Chao, 1959: 41, 196, pl. 3, figs. 1, 2.

Celtites kcirensis,—Renz and Renz (non Arthaber), 1948: 42, pl. 3, fig. 3 (non fig. 6).

This is another very distinctive species first described from the *Subcolumbites* fauna of Albania. Unfortunately, none of Arthaber's types are preserved in the Paleontological Institute, Vienna. The specimen recorded by Renz and Renz (1948: 55) is illustrated here on Plate 25, figures 9, 10. The inner whorls of this specimen, up to a diameter of 14 mm, are exposed, and these show the whorl section to be approximately as wide as it is high and the venter to be broadly rounded. It is in the following volutions that the whorls become compressed and the venter acute. The suture is nearly identical to that of Arthaber's holotype (Fig. 4E). Another representative of this species in the Chios fauna is one of the specimens Renz and Renz (1948: 42, pl. 3, fig. 3) assigned to *Celtites kcirensis*.

The specimen recorded by Chao (1959) yielded no suture, but the distinctive morphology of this species suggests that the specimen from Kwangsi, China, is conspecific with the Albanian and Chios specimens of *H. discus*.

The only other species of *Hemilecanites* is *H. paradiscus* n. sp. from the *Subcolumbites* fauna of the Tobin Formation, Nevada. This new species is quite similar to *H. discus*, but it is a more compressed and involute form with commensurate changes in the localization of the sutural elements (Fig. 4F).

Occurrence. *Subcolumbites* fauna of Albania, Chios, and Kwangsi, China (Chao collection 610).

Repository. The holotype is supposed to be in the Paleontological Institute, Vienna, but has not been located and is presumed lost; however, four topotype specimens are in the British Museum (Natural History), C22875–8. The plesiotype (Pl. 25, figs., 9, 10) from Chios is NHMB J13703; the plesiotype of *Celtites kcirensis*,—Renz and Renz (non Arthaber) 1948: pl. 3, fig. 3, is NHMB J13653.

Hemilecanites paradiscus n. sp.

Plate 29, figures 11, 12; Plate 31, figures 15, 16; Plate 35, figure 12; Text-figure 4

There are nine, mostly incomplete, specimens in the collection from the Tobin Formation, only two of which are complete enough to yield the following measurements:

	D	W	H	U	W/D	H/D	U/D
Holotype (MCZ 9465)	21.1	3.4	8.0	6.8	16.2	37.9	32.2
Paratype (MCZ 9451)	15.8	3.2	6.7	4.8	20.2	42.4	30.3

The conch is much compressed, lenticular in cross section. The venter is narrowly rounded to oxynote. The flanks are only slightly convex and the umbilical shoulder and wall very low. The shell is perfectly smooth except for extremely fine radial growth lines. None of the specimens are sufficiently complete to show the apertural regions. The sutures are shown on Figure 4F, G.

There is no question but this species is closely related to *H. discus*. It differs in its greater compression and involution and in the spacing of the sutural elements.

Occurrence. Tobin Formation, Pershing County, Nevada; south tip of Tobin Range, Cain Mountain 1:62,500 quad., center NW ¼ sec. 9, T. 26N, R. 39E, 5,500 ft. S., 27.5 ft. W from elevation point 5088 on range crest.

Repository. Holotype MCZ 9465 (Pl. 31, figs. 15, 16); paratype MCZ 9451 (Pl. 29, figs. 11, 12), MCZ 9473 (Pl. 35, fig. 12); suture specimens MCZ 9631, 9483; unfigured paratypes MCZ 9483.

Superfamily NORITACEAE Karpinsky, 1889
Family XENOCELTITIDAE Spath, 1930
Genus *Xenoceltites* Spath, 1930
Type species, *Xenoceltites subevolutus* Spath, 1930

The genus *Xenoceltites* is very widely distributed in the mid-Scythian *Owenites* Zone where it is represented by a fairly

large number of species. In the overlying *Columbites* Zone the genus is represented by a single species (*X. spencei*) known only from southeast Idaho. In the late Scythian *Prohungarites* Zone there are only three species, one each from the Salt Range, China, and Primorye Region. In each case these species are represented by very few specimens. An indeterminant species of this genus has been recorded from the *Subcolumbites* fauna at Kotal-e-Tera, Afghanistan (Kummel, 1968b).

Xenoceltites sinuatus (Waagen)

Dinarites sinuatus Waagen, 1895: 33, pl. 10, fig. 4; Diener, 1915: 122.
Xenoceltites sinuatus Chao, 1959: 194; Kummel, 1966: 389, pl. 1, figs. 1–8.
Lecanites laqueus Waagen, 1895: 285, pl. 38, figs. 9, 10.
Xenodiscus laqueus Diener, 1915: 313.

This species has been recently described and illustrated (Kummel, 1966: 389) on the basis of new specimens. Among the few upper Scythian species of *Xenoceltites* known, this species is most similar to *X. crenoventrosus* Chao (1959) from Kwangsi, China. There is close agreement on the suture and general conch shape, but the pattern of ornamentation is different.

Occurrence. Sandstone beds of Narmia Member of Mianwali Formation, just above hard Bivalve Limestone, Chhidru Nala, Salt Range, West Pakistan.

Repository. Holotype GSI 7110; topotypes MCZ 9581, 9582.

Xenoceltites crenoventrosus Chao

Xenoceltites crenoventrosus Chao, 1959: 38, 194, pl. 3, figs. 14–15, pl. 42, figs. 2–6, text-fig. 8a–c.

The description and illustration of this species are inadequate. The conch is of the general form of *X. sinuatus*, but the ribs cross the venter forming a distinctive crenulated pattern. The suture is quite like that of *X. sinuatus*.

Occurrence. *Subcolumbites* fauna, Kwangsi, China (Chao collection 542b).

Xenoceltites spitsbergensis Spath

Xenoceltites spitsbergensis Spath, 1934: 128, pl. 9, figs. 1, 2, pl. 11, figs. 5, 7, 8; Kiparisova, 1961: 50, pl. 9, figs. 7, 8.

This species is recognized on the basis of two very small specimens of 21 and 15 mm in diameter. Even so, the similarity to the Spitsbergen xenoceltitids is quite striking, and I can do no more than agree with Kiparisova's determination. The type specimens of this species, from Spitsbergen, are of mid-Scythian *Owenites* Zone age and this specimen is said to have come from strata with *Subcolumbites*.

Occurrence. *Subcolumbites* fauna, Primorye Region, Siberia.

Xenoceltites spencei (Hyatt and Smith) Plate 48, figures 5–9; Plate 52, figures 1–7; Text-figures 7, 8

Ophiceras spencei Hyatt and Smith, 1905: 119, pl. 62, figs. 1–10; Diener, 1915: 212; Smith, 1932: 50, pl. 62, figs. 1–10.

The middle shale member of the Thaynes Formation around Bear Lake, southeast Idaho, that contains the *Columbites* fauna has yielded an abundance of specimens of this species. Measurements of 99 specimens are given in Table 25 and the variations in whorl width and height are plotted on Figure 8. The forward projecting constrictions that cross the venter are quite variable in their intensity. As noted by Smith (1932: 50) these constrictions are most noticeable on the cast; in many of the specimens they are not at all apparent or expressed on the shell. The suture consists of two denticulated lateral lobes and is quite variable in details of the basic pattern (Fig. 7).

This species is not really comparable or very close to any of the upper Scythian species assigned to *Xenoceltites*, as *sinuatus*, *crenoventrosus*, or the species assigned by Kiparisova (1961) to *X. spitsbergensis*. It is however, quite similar in its over-all aspect to the Spitsbergen forms Spath (1934) assigned to *X. subevolutus*, *X. gre-*

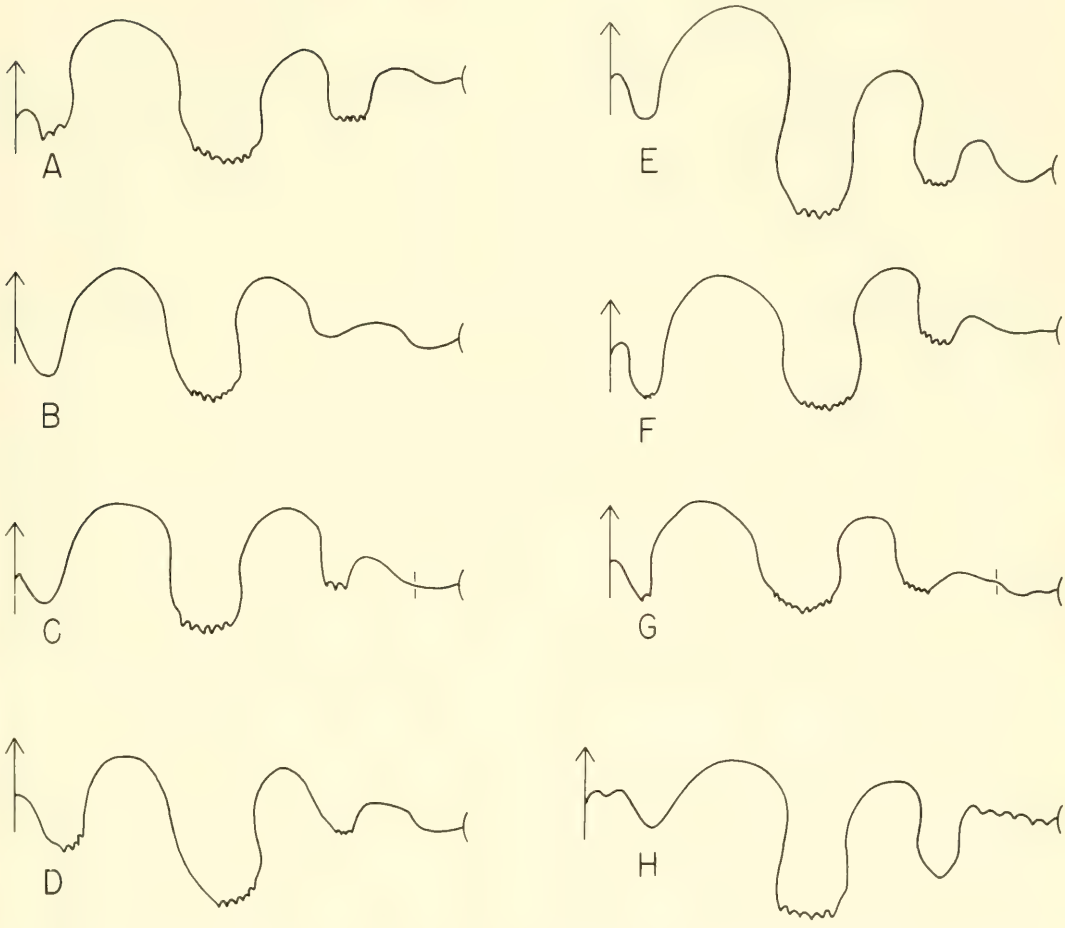

Figure 7. Diagrammatic representation of the sutures of *Xenoceltites spencei* (Hyatt and Smith), from the *Columbites* fauna, Thaynes Formation of southeastern Idaho. A, at a diameter of 17 mm (MCZ 9558); B, at a diameter of 21 mm (MCZ 9559); C, at a diameter of 18 mm (MCZ 9560); D, at a diameter of 22 mm (MCZ 9561); E, at a diameter of 13 mm (MCZ 9562); F, at a diameter of 24 mm (MCZ 9563); G, at a diameter of 34 mm (MCZ 9551, Pl. 52, fig. 1); H, paralectotype (Hyatt and Smith, 1905: pl. 62, figs. 5–7; Pl. 48, figs. 5, 6 of this report), at a diameter of 28 mm (USNM 75291b).

Specimens of figures A, C, D, from Hot Springs, B, E, F, G from Montpelier Canyon, H, from Paris Canyon.

goryi, or *X. spitsbergensis*, all of mid-Scythian, *Owenites* Zone, age.

Occurrence. Middle shale member of Thaynes Formation, *Columbites* Zone, at Paris Canyon, Montpelier Canyon, and Hot Springs, Bear Lake region, and Draney Creek, southeast Idaho.

Repository. Lectotype (Pl. 48, figs. 7–9) USNM 75291a; paralectotype (Pl. 48, figs. 5, 6) USNM 75291b, paralectotype (Hyatt and Smith, 1905: pl. 62, figs. 8–10) USNM 75291c; plesiotypes (Pl. 52, fig. 1) MCZ 9551, (Pl. 52, fig. 2) MCZ 9552, (Pl. 52, fig. 3) MCZ 9553, (Pl. 52, fig. 4) MCZ 9554, (Pl. 52, fig. 5) MCZ 9555, (Pl. 52, fig. 6) MCZ 9556, (Pl. 52, fig. 7) MCZ 9557; suture specimens Figure 7, MCZ 9551, 9558–9563; specimens from Montpelier Canyon MCZ 9630, from Hot Springs MCZ 9629.

TABLE 25. MEASUREMENTS OF *XENOCELTITES SPENCEI* (HYATT AND SMITH) FROM THE *COLUMBITES* FAUNA, BEAR LAKE REGION, SOUTHEASTERN IDAHO.

	D	W	H	U	W/D	H/D	U/D		D	W	H	U	W/D	H/D	U/D
1.	51.5	?	16.2	19.8	?	31.5	38.4	47.	20.1	5.8	7.8	6.6	28.9	38.8	32.8
2.	49.8	10.5	14.5	21.8	21.1	29.1	43.8	48.	20.0	5.2	7.6	6.4	26.0	38.0	32.0
3.	46.4	11.0	16.2	19.2	23.7	34.9	41.4	49.	20.0	5.3	8.2	6.6	26.5	41.0	33.0
4.	45.8	11.4	17.4	16.1	24.9	37.9	35.2	50.	20.0	6.3	8.0	6.7	31.5	40.0	33.5
5.	42.3	9.4	15.0	16.3	22.2	35.5	38.5	51.	19.8	5.6	8.2	6.3	28.3	41.4	31.8
6.	42.3	10.5?	13.8	18.6	24.8?	32.6	43.9	52.	19.8	5.5	7.8	6.9	27.8	39.4	34.8
7.	40.8	10.9	15.7	13.4	26.7	38.5	32.8	53.	19.7	5.8	7.3	7.0	29.4	37.1	35.5
8.	40.7	10.0	14.4	15.2	24.6	35.4	37.3	54.	19.7	6.0	8.5	5.7	30.5	43.1	28.9
9.	40.0	10.0	16.0	12.2	25.0	40.0	30.5	55.	19.7	6.6	7.2	6.1	33.5	36.5	30.9
10.	39.4	9.4	12.7	17.3	23.9	32.2	43.9	56.	19.5	6.0	8.3	5.9	30.8	42.6	30.3
11.	33.4	9.0	15.0	8.7	26.9	44.9	26.0	57.	19.5	5.7	8.2	5.7	29.2	42.1	29.2
12.	33.2	7.8	10.8	14.0	23.5	32.5	42.2	58.	19.2	6.2	8.0	5.9	32.2	41.7	30.7
13.	31.8	7.8	12.2	11.3	24.5	38.4	35.5	59.	19.1	6.0	8.7	5.2	31.4	45.5	27.2
14.	31.7	8.2	12.3	10.3	25.9	38.8	32.5	60.	19.0	6.0	7.2	6.5	31.6	37.9	34.2
15.	30.6	8.1	10.6	12.6	26.5	34.6	41.2	61.	19.0	6.0	7.3	6.4	31.6	38.42	33.7
16.	30.5	6.6	10.2	12.6	21.6	33.4	41.3	62.	19.0	6.2	8.0	5.6	32.6	42.1	29.5
17.	29.7	8.3	13.1	7.7	27.9	44.1	25.9	63.	18.8	5.6	7.7	6.0	29.8	40.9	31.9
18.	29.2	7.5	10.7	10.8	25.7	36.6	36.9	64.	18.4	5.6	7.1	6.6	30.4	38.9	35.9
19.	29.0	7.4	11.4	9.7	25.5	39.3	33.4	65.	18.2	5.7	7.0	6.3	31.3	38.5	34.6
20.	28.8	7.6	10.2	11.0	26.4	35.4	38.2	66.	18.0	4.6	7.1	6.5	25.6	39.4	36.1
21.	26.7	7.5	9.8	10.0	28.1	36.7	37.5	67.	17.8	5.8	7.3	5.7	32.6	41.0	32.0
22.	26.5	7.1	10.2	9.3	26.8	38.5	35.1	68.	17.8	5.5	7.1	6.1	30.9	39.9	34.3
23.	25.4	7.2	9.0	9.4	28.3	35.4	37.0	69.	17.5	5.3	6.6	6.4	30.3	37.7	36.6
24.	25.3	6.8	6.8	9.6	26.9	26.9	37.9	70.	17.5	5.8	6.3	6.8	33.1	36.0	38.9
25.	25.3	6.9	10.6	8.3	27.3	41.9	32.8	71.	17.5	5.7	7.2	5.4	32.6	41.1	30.9
26.	25.3	7.3	9.7	9.3	28.9	38.3	36.8	72.	17.5	5.2	6.1	6.7	29.7	34.9	38.3
27.	24.6	6.4	9.4	8.7	26.0	38.2	35.4	73.	17.4	4.8	7.2	6.1	27.6	41.4	35.1
28.	24.3	6.8	9.1	9.8	27.9	37.4	40.3	74.	17.3	5.4	7.4	5.3	31.2	42.8	30.6
29.	24.0	6.8	10.2	7.0	28.3	42.5	29.2	75.	17.2	5.5	7.0	5.6	31.9	40.7	32.6
30.	23.5	?	10.0	7.0	?	42.6	29.8	76.	17.1	5.0	6.5	5.3	29.2	38.0	30.9
31.	23.5	6.7	8.3	9.3	28.5	35.3	39.6	77.	17.0	6.0	6.8	5.1	35.3	40.0	30.0
32.	23.3	6.5	9.4	7.4	27.9	40.3	31.8	78.	16.9	5.3	6.7	6.1	31.4	39.6	36.1
33.	23.3	6.5	9.3	8.0	27.9	39.9	34.3	79.	16.8	5.5	6.5	6.0	32.7	38.7	35.7
34.	23.3	6.4	9.6	7.8	27.5	41.2	33.5	80.	16.6	5.2	5.6	7.1	31.3	33.7	42.8
35.	23.2	6.2	9.0	6.2	26.7	38.8	26.7	81.	16.5	5.1	6.2	5.8	30.9	37.6	35.2
36.	23.0	6.4	8.7	8.2	27.8	37.8	35.7	82.	16.3	5.3	6.3	5.3	32.5	38.7	32.5
37.	23.0	6.3	9.1	7.2	27.4	39.6	31.3	83.	15.9	5.2	6.7	5.0	32.7	42.1	31.4
38.	21.7	?	9.0	6.9	?	41.5	31.8	84.	15.6	5.2	6.7	4.8	33.3	42.9	30.8
39.	21.7	6.2	8.3	8.2	28.6	38.2	37.8	85.	15.2	5.1	6.2	4.6	33.6	40.8	30.3
40.	21.5	7.5	9.4	6.6				86.	15.0	5.3	6.1	5.0	35.3	40.7	33.3
41.	21.3	6.6	9.0	7.1	30.9	42.3	33.3	87.	15.0	5.2	5.7	5.7	34.7	38.0	38.0
42.	21.1	6.3	8.1	7.6	29.9	38.4	36.0	88.	14.8	5.1	5.9	5.1	34.5	39.9	34.5
43.	21.0	6.3	9.7	5.0	30.0	46.2	23.8	89.	14.7	4.7	5.7	5.5	31.9	38.8	37.4
44.	20.8	5.2	8.7	6.4	25.0	41.8	30.8	90.	14.6	4.5	6.1	5.0	30.8	41.8	34.2
45.	20.7	6.0	9.4	6.1	28.9	45.4	29.5	91.	14.6	5.2	5.6	4.8	35.6	38.4	32.9
46.	20.6	5.4	8.4	6.8	26.2	40.7	33.0	92.	14.4	4.9	5.8	4.4	34.0	40.3	30.6

4. Plesiotype, MCZ 9551 (Pl. 52, fig. 1).
7. Paralectotype, USNM 75291b (Pl. 48, figs. 5, 6).
9. Lectotype, USNM 75291a (Pl. 48, figs. 7–9).
15. Plesiotype, MCZ 9556 (Pl. 52, fig. 6).
21. Plesiotype, MCZ 9554 (Pl. 52, fig. 4).
23. Plesiotype, MCZ 9552 (Pl. 52, fig. 2).
24. Suture specimen, MCZ 9563 (Fig. 7F).
36. Suture specimen, MCZ 9561 (Fig. 7D).
39. Suture specimen, MCZ 9560 (Fig. 7C).
76. Plesiotype, MCZ 9555 (Pl. 52, fig. 3).

TABLE 25. *Continued*

	D	W	H	U	W/D	H/D	U/D		D	W	H	U	W/D	H/D	U/D
93.	14.2	4.8	4.8	5.3	33.8	33.8	37.3	97.	12.2	4.1	4.2	4.0?	33.6	34.4	32.8?
94.	14.0	4.9	5.1	5.4	35.0	36.4	38.6	98.	11.0	4.0	4.2	3.9	36.4	38.2	28.0
95.	13.6	4.9	5.2	4.8	36.0	38.2	35.3	99.	8.3	3.1	2.8	3.2	37.3	33.7	38.6
96.	13.4	4.5	5.1	4.8	33.6	38.1	35.8								

96. Suture specimen, MCZ 9562 (Fig. 7E).
98. Plesiotype, MCZ 9557 (Pl. 52, fig. 7).

Genus *Preflorianites* Spath, 1930
Type species, *Danubites strongi* Hyatt and Smith, 1905

Evolute forms with arched venters, often tending to become acute; with radial ribbing, most pronounced on inner lateral areas near umbilical shoulders and not crossing the venter; suture with two lateral lobes.

Preflorianites is quite a generalized ammonite. This, accompanied by the fact that it is not particularly abundant in the upper half of the Scythian, has made analysis of the species described to date very difficult. The late Scythian species of *Preflorianites* recognized here are:

Preflorianites sulioticus (Arthaber)
Preflorianites garbinus (Renz and Renz)
Preflorianites multiplicatus (Mojsisovics)
Preflorianites intermedius Tozer

In addition, the *Columbites* fauna of southeast Idaho has yielded one species, *P. montpelierensis.*

I am not at all certain as to the merits of all these species. Each is known from only one or very few specimens; thus little or no data are available on the range of variation in rib patterns, degree of involutions, shape of whorl sections, suture, etc. Few meaningful comparisons can be made between one species group and the others.

The late Scythian species are known from the *Subcolumbites* fauna of Albania (*sulioticus*), the *Subcolumbites* fauna of Chios (*sulioticus, garbinus*), the *Olenekites* fauna of the Olenek River region (*multiplicatus*), from a late Scythian fauna of British Columbia (*intermedius*), and from the *Columbites* fauna of southeast Idaho (*montpelierensis*).

Preflorianites sulioticus (Arthaber)
Plate 4, figures 5, 6; Plate 19, figures 1, 2, 5–8; Text-figure 9

Xenodiscus sulioticus Arthaber, 1911: 229, pl. 19(3), figs. 6a, b, pl. 20(4), figs. 2a, b; Diener, 1915: 315; C. Renz, 1928: 155; Renz and Renz, 1947: 61; Renz and Renz, 1948: 56, pl. 3, figs. 1, 2.
Preflorianites sulioticus,—Spath, 1934: 133, pl. 12, figs. 2a–d.
Ophiceras cfr. *Nangaensis* Arthaber (1911: 239, pl. 21(5), fig. 5) non Waagen.
Xenodiscus sp. ind. aff. *Nangaensis*,—Diener, 1915: 313.

Arthaber (1911: 230) states he had four specimens of this species; only the two specimens he illustrated are still preserved. It is of interest that whereas Arthaber had only four specimens for study, the British Museum (Natural History) has fifteen topotypes obtained by purchase. The description of the species by Arthaber (1911) and the comments by Spath (1934: 133) are adequate for the two syntypes even though the specimens are poorly preserved. The specimens of this species figured by Renz and Renz (1948, pl. 3, figs. 1, 2) are very typical forms. They clearly show that the adoral decrease in ribbing intensity is highly variable, taking place at different growth stages.

The two specimens which Arthaber (1911) assigned to *Ophiceras* cfr. *nangaensis* are both poorly preserved and owe many of their morphological features to excessive grinding and polishing. One of the specimens (Pl. 19, figs. 1, 2) shows indications

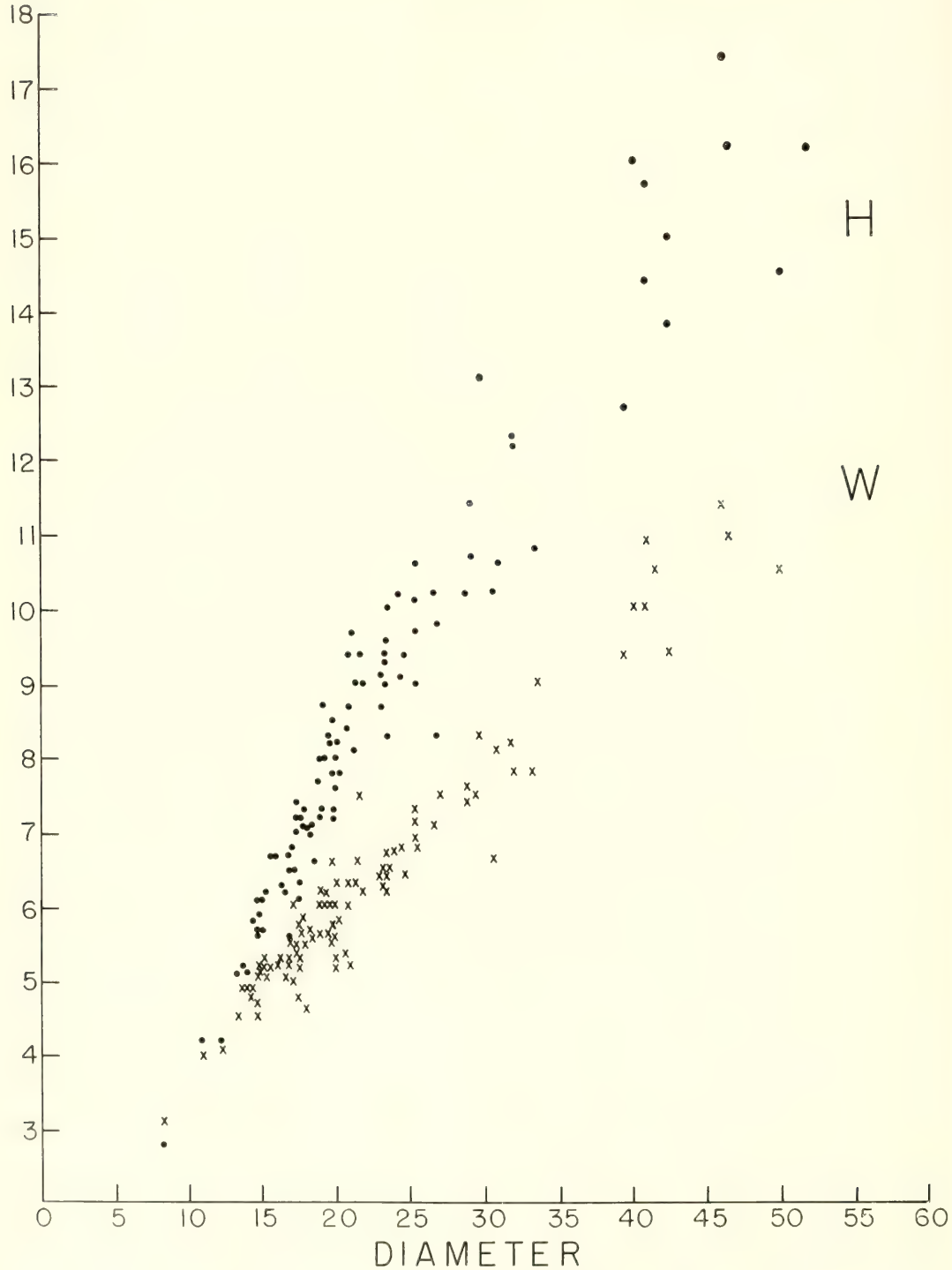

Figure 8. Variation in whorl height (H) and whorl width (W) of *Xenoceltites spencei* (Hyatt and Smith) from *Columbites* fauna, Bear Lake region, southeast Idaho. The data on this graph are from Table 25.

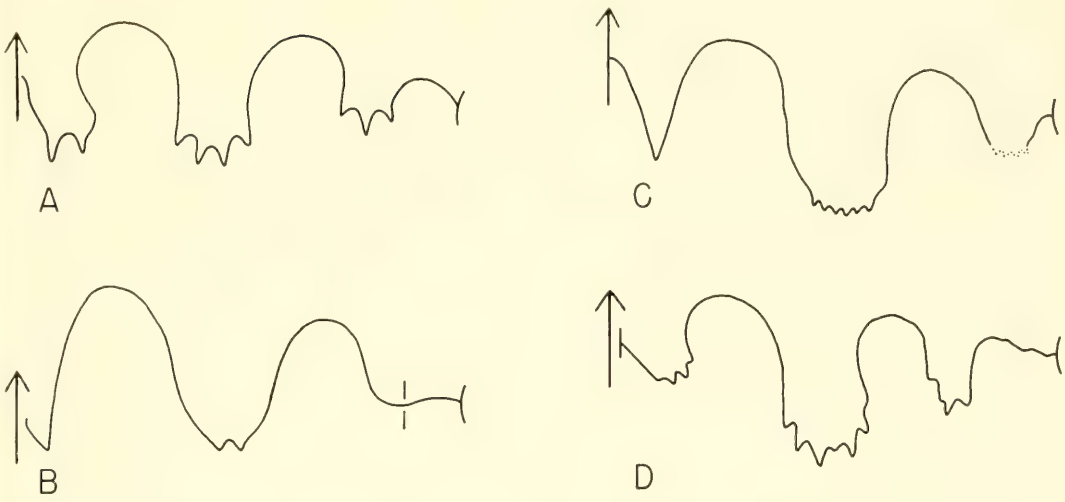

Figure 9. Diagrammatic representation of the suture of: A, *Preflorianites sulioticus* (Arthaber, 1911: pl. 20(4), fig. 2b), from *Subcolumbites* fauna of Albania, at a diameter of approximately 20 mm; B, *Preflorianites garbinus* (Renz and Renz), from *Subcolumbites* fauna of Chios (NHMB J13696), at a diameter of 25 mm; C, *Preflorianites montpelierensis* n. sp., from *Columbites* fauna, southeast Idaho (MCZ 9498), at a whorl height of 5 mm; D, *Preflorianites strongi* (Hyatt and Smith, 1905: pl. 9, fig. 6), from *Meekoceras* fauna, Inyo Range, California, at a diameter of approximately 30 mm.

of ribs on the umbilical shoulder; the ribbing has been completely ground away on the flanks. Both these specimens I believe are representatives of *P. sulioticus*. A suture of *Preflorianites sulioticus* is illustrated on Figure 9A.

Occurrence. *Subcolumbites* fauna of Albania and Chios.

Repository. The two syntypes from Albania and the two specimens of *Ophiceras* cfr. *nangaensis* are in the Paleontological Institute, Vienna. The specimens from Chios are NHMB J13704 (Renz and Renz, 1948, pl. 3, fig. 1), NHMB J13705 (Renz and Renz, 1948, pl. 3, fig. 2); unfigured specimens from Maradovuno NHMB J13706.

Preflorianites garbinus (Renz and Renz)
Plate 20, figures 10, 11; Text-figure 9

Inyoites n. sp. C. Renz, 1947: 176.
Inyoites garbinus Renz and Renz, 1947: 60, 76; Renz and Renz, 1948: 53, pl. 12, figs. 10–10b.

The single specimen in the Chios fauna studied by the Renzes for which they introduced this new species name is indeed superficially similar to *Inyoites*. However, the venter is acute but does not bear a keel as in the typical *Inyoites* from the *Meekoceras* fauna of western North America. Likewise, the typical *Inyoites* have a vertical umbilical wall whereas this Chios specimen has a rounded umbilical wall. The specimen is slightly weathered, and thus the fine denticulations of the suture are lost and the suture as drawn (Fig. 9B) is that of the weathered surface. A second specimen in the Chios collection but not mentioned by the Renzes is illustrated here on Plate 20, figures 10, 11. It is a slightly more inflated form than the holotype but even more preflorianitid in aspect.

It is for the above reasons that this species is believed to be a much compressed species of *Preflorianites*. The Chios fauna contains a very "typical" species of *Preflorianites*—*P. sulioticus* (Arthaber)—which has a much more inflated whorl section. Unfortunately, *P. sulioticus* is represented by only two specimens in the Chios fauna, and *P. garbinus* by only two specimens; thus the relationship between these two

species must remain uncertain until more material becomes available.

Occurrence. Subcolumbites fauna, Maradovuno, Chios.

Repository. Holotype NHMB J13696; paratype (Pl. 20, figs. 10, 11) NHMB J13697.

Preflorianites multiplicatus (Mojsisovics)

Ceratites multiplicatus Mojsisovics, 1886: 25, pl. 9, figs. 15a, b.
Xenodiscus multiplicatus,—Diener, 1915: 313; Popov, 1961: 7.
"Ceratites" multiplicatus,—Spath, 1934: 128.
Xenoceltites multiplicatus,—Kummel, 1961: 521.
Ceratites fissiplicatus Mojsisovics, 1886: 26, pl. 9, figs. 18a, b, 19c.
Xenodiscus fissiplicatus,—Diener, 1915: 312; Popov, 1961: 7.
Ceratites discretus Mojsisovics, 1886: 27, pl. 9, figs. 20a–c.
Xenodiscus discretus,—Diener, 1915: 312; Popov, 1961: 7.
Xenoceltites discretus,—Kummel, 1961: 521.
Ceratites hyperboreus Mojsisovics, 1886: 26, pl. 9, figs. 16, 17.
Xenodiscus hyperboreus,—Diener, 1915: 313.
Xenoceltites hyperboreus,—Kummel, 1961: 521.

It is apparent from the five specimens illustrated by Mojsisovics (1886, pl. 9, figs. 15–20) and brought together here as representing a single species that there is considerable variability in the ribbing patterns. The Olenek fauna has recently been monographed by Popov (1961), but in this extensive revision none of these species are described or illustrated; they are merely mentioned in a summary list of species from the *Olenekites* Zone.

Occurrence. Olenekites Zone in region of Olenek River, northern Siberia.

Preflorianites intermedius Tozer

Preflorianites intermedius Tozer, 1965a: 18, pl. 11, figs. 92–6, text-fig. 2.

This species is based on a single fragmentary specimen and in outward appearance is very much like nearly all other upper Scythian specimens of this genus. The smallness of all the samples, however, prevents any meaningful comparisons.

Occurrence. Toad Formation, Halfway River area, British Columbia, associated with *Popovites occidentalis* and *Monacanthites monoceros.*

Preflorianites montpelierensis n. sp.
Plate 43, figures 2, 3; Plate 44, figures 11–13; Text-figure 9

The *Columbites* fauna of southeastern Idaho has yielded thirteen specimens of this interesting species. The conch is evolute, compressed, and small. The inner volutions have whorls which are approximately as wide as high with rounded venters, and slightly convex lateral areas and rounded umbilical shoulders. The lateral areas bear radial ribs that are projected forward on the ventral shoulder. In general the venter is smooth, but occasionally there are constrictions crossing the venter, constrictions which are the continuation of rib interspaces on the lateral areas. The number and prominence of these constrictions are highly variable; the most pronounced development is in the specimen shown on Plate 43, figures 2, 3.

The length of the body chamber is not known for sure, but it is at least more than half a volution. The body chamber is much more compressed than the phragmocone and the venter becomes narrowly rounded, the lateral areas convergent. Likewise, the radial ribs become very subdued.

The suture is of a simple ceratite plan with two lateral lobes (Fig. 9C).

This species is not unduly different from the other upper Scythian species of *Preflorianites.* In its somewhat compressed whorls this species is especially like *P. garbinus* from the *Subcolumbites* fauna of Chios.

Occurrence. Middle shale member of Thaynes Formation, *Columbites* fauna at Montpelier Canyon and Hot Springs, southeast Idaho.

Repository. Holotype, MCZ 9494 (Pl. 44, fig. 13); figured paratypes MCZ 9495 (Pl. 43, figs. 2, 3), MCZ 9498 (Pl. 44, fig. 12), MCZ 9635 (Pl. 44, fig. 11); unfigured paratypes from Montpelier Canyon MCZ 9497, from Hot Springs MCZ 9496.

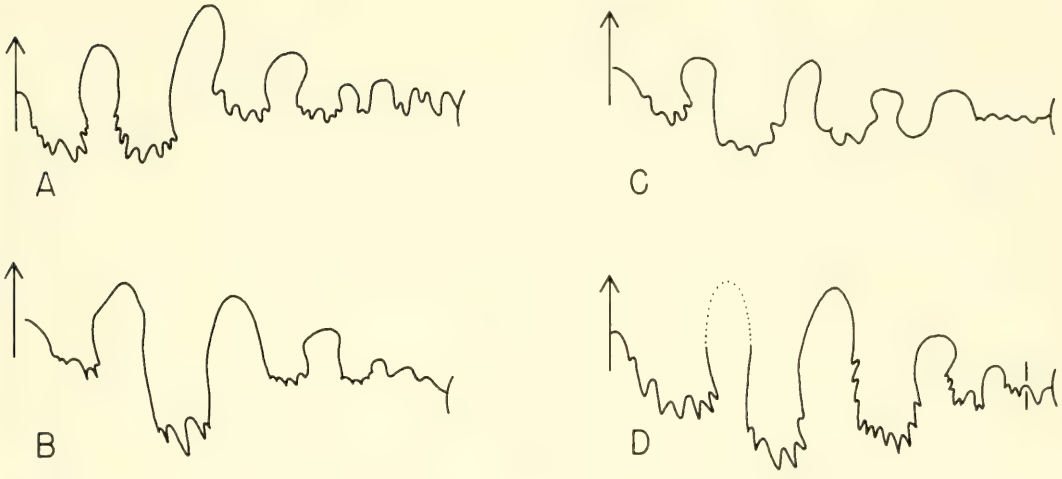

Figure 10. Diagrammatic representation of the suture of: A, holotype of *Pseudaspidites popovi* n. sp., from *Columbites* fauna of southeast Idaho, at a diameter of 48 mm (MCZ 9575); B, paratype *Pseudaspidites popovi* n. sp., from *Columbites* fauna of southeast Idaho, at a diameter of 28 mm (MCZ 9636); C, holotype *Pseudaspidites posterius* (Popov, 1961: fig. 9), from *Dienerceras* Zone, northern Siberia; D, *Pseudaspidites yudishthira*,—Krafft and Diener (1909: pl. 15, fig. 5), from *Hedenstroemia* fauna of the Himalayas.

Family PARANORITIDAE Spath, 1930

Genus *Pseudaspidites* Spath, 1934

Type species, *Aspidites muthianus* Krafft and Diener, 1909

Pseudaspidites popovi n. sp.

Plate 44, figures 14, 15; Plate 55, figures 8, 9; Text-figure 10

This species is based on two specimens that are all phragmocone. The larger specimen and holotype has an approximate diameter of 63 mm, the width of the most adoral part of the last volution is 14.8 mm, the height is 34.7 mm, and the diameter of the umbilicus is 4.9 mm. The venter is narrowly rounded, the lateral areas broadly arched. The umbilical shoulders are sharply rounded. The lateral areas bear slightly sinuous, narrow, low ribs and fine growth lines. The suture is shown on Figure 10A. The smaller specimen measures 32.3 mm in diameter, 7.8 mm for the width of the adoral whorl, 17.4 mm for the height, and 4.5 mm for the diameter of the umbilicus. The suture is shown on Figure 10B.

The general configuration of the conch and the suture clearly allies this species with *Pseudaspidites*. This genus is a fairly common member of the mid-Scythian *Owenites* Zone; species of it are known from the *Meekoceras* Zone of Idaho and Nevada (*P. wheeleri* Kummel and Steele, 1962: 673), from the *Hedenstroemia* fauna of the Himalayas (*P. muthianus* and *P. yudishthira*,—Krafft and Diener, 1909), and from mid-Scythian horizons in northern Siberia (*Clypeoceras gantmani* Popov, 1961: 49). The basic outline and elements of the suture are quite similar in all these species, but there is a particularly close similarity of the suture of this species to the suture of *P. yudishthira* Diener from the *Hedenstroemia* fauna of Muth, Himalayas (Fig. 10D).

The present species is from the *Columbites* Zone of southeastern Idaho and thus is younger than the species mentioned above. This, in fact, is the first recognition of a species of *Pseudaspidites* from a zone younger than that of *Meekoceras* (or *Owenites*).

The fauna of the *Dieneroceras* Zone of northern Siberia described by Popov (1961) I believe to be contemporaneous with that

of the *Columbites* fauna of southeastern Idaho. This Siberian fauna contains one species—*Koninckites posterius* Popov (1961: 51, pl. 4, fig. 2)—that is very similar to *Pseudaspidites popovi*. This species clearly belongs in *Pseudaspidites* and not in *Koninckites*. The principal differences between these species are in details of the suture (Fig. 10C).

Occurrence. Middle shale member of Thaynes Formation, *Columbites* Zone, Hot Springs, southeastern Idaho.

Repository. Holotype, MCZ 9575; paratype MCZ 9636.

Pseudaspidites posterius (Popov)
Text-figure 10

Koninckites posterius Popov, 1961: 51, pl. 4, fig. 2.

This species is remarkably similar in conch form to *P. popovi* described above. The sutures are likewise quite similar (Fig. 10); the differences center mainly in the length of the lobes and in the auxiliary series. Popov compared his species with *Koninckites septentrionalis* Diener (1895: pl. 1, figs. 1a–c) from the Primorye Region and *Meekoceras timorensis* Wanner (1911: 185, pl. 6, fig. 2, pl. 7, figs. 5, 6) from Timor. There is a superficial resemblance between these forms but both these species are approximately mid-Scythian in age, whereas *P. posterius* comes from a younger horizon contemporaneous with the *Columbites* fauna of Idaho.

Occurrence. Dieneroceras Zone of Popov (1961), delta of the Lena River, Siberia.

Family PROPTYCHITIDAE Waagen, 1895
Genus *Proptychitoides* Spath, 1930
Type species, *Proptychitoides decipiens* Spath, 1930
(= *Proptychites latifimbriatus* Arthaber, 1911, non de Koninck)

Some of the more conspicuous upper Scythian ammonites belong to this genus; they are likewise often some of the biggest forms in a fauna. Arthaber (1911) first recognized the group in the *Subcolumbites* fauna from Albania. At that time he allied the group to the *Proptychites* described by Waagen (1895) from the Salt Range, noting, however, that his Albanian species differed from the Salt Range species in the more coarsely denticulated lobes and the club-shaped, asymmetrical saddles of the suture. Spath (1930: 30; 1934: 171) has correctly summarized the major aspects of these two species groups and introduced the genus *Proptychitoides* for the Albanian forms. This change has been widely accepted.

Since the first recognition of the group within the *Subcolumbites* fauna of Albania, it has been recorded from the same horizon in Kwangsi, China, and Timor. In addition, it was recorded from a horizon of uncertain position in the upper Scythian in northern Siberia. The previous studies of forms in these several faunas which I believe to belong in *Proptychitoides* have resulted in the introduction of 22 species names included within seven genera. Reexamination of all the available specimens from all but the fauna from Kwangsi, China, leads me to conclude that there are only five valid species of *Proptychitoides*. The species of *Proptychitoides* recognized as valid are:

Proptychitoides decipiens Spath
Proptychitoides trigonalis (Arthaber)
Proptychitoides arthaberi (Welter)
Proptychitoides tunglanensis Chao
Proptychitoides kummeli (Popov)

It is only in the *Subcolumbites* faunas of Albania and Chios that two species (*decipiens* and *trigonalis*) occur together. In all the other faunas mentioned above only a single species is present. The Albanian and Chios species differ in the degree of involution, degree of inflation of the whorls, and in ornamentation, but their sutures are essentially identical. *Proptychitoides decipiens* is the more involute, compressed species, and *P. trigonalis* is the more evolute form with a more inflated whorl. *Proptychitoides arthaberi* from Timor and *P.*

tunglanensis from Kwangsi, China, have the same general shell architecture as *P. decipiens*; unfortunately, the suture in both of these species is not as well known as would be desired. The suture of *P. arthaberi*, reproduced on Figure 11L, had, according to Welter (1922), less distinctly rounded saddles. Spath, however (1934: 177), on examination of one topotype specimen found this not to be the case. Due to poor preservation and incomplete data, it is not possible to make detailed comparisons with *P. tunglanensis*. Both these species could well be conspecific with *P. decipiens* from Albania and Chios; they are unfortunately known from so few specimens that a complete analysis of their characters is not yet possible.

There is one other Eurasian species of *Proptychitoides*, *P. kummeli* (Popov), from the Olenek River region of northern Siberia. This species has the general shell architecture of *P. trigonalis*, that is, somewhat evolute with an inflated whorl, and a suture very much like that given by Welter (1922) for *P. arthaberi* (Fig. 11K, L), and thus, is of the general plan of the Albanian and Chios species of *Proptychitoides*.

Proptychitoides decipiens Spath
Plate 8, figures 1–4; Plate 12, figure 3; Text-figure 11

Proptychites latifimbriatus,—Arthaber (non de Koninck), 1911: 223, pl. 19(3), figs. 1, 2; Renz, 1928: 155.

Proptychites sp. ind. aff. *latifimbriata*,—Arthaber (non de Koninck),—Diener, 1915: 231.

Proptychitoides decipiens Spath, 1930: 39; Spath, 1934: 171, figs. 51a, b; Kummel, *in* Arkell et al., 1957: L138, fig. 171, 6.

Proptychites kraffti Arthaber, 1911: 224, pl. 19(3), fig. 3; Diener, 1915: 231.

Proptychitoides kraffti,—Spath, 1934: 174, fig. 51c.

Meekoceras hakki Arthaber, 1911: 247, pl. 22(6), figs. 1, 2; Diener, 1915: 192.

Proptychitoides hakki,—Spath, 1934: 176, fig. 51e.

Proptychites balcanicus Renz and Renz, 1947: 61, 77; Renz and Renz, 1948: 66, pl. 5, figs. 9–9a.

Proptychites lawrencianus (de Koninck). mut. *postindica* Renz and Renz, 1947: 61, 77; Renz and Renz, 1948: 67, pl. 5, figs. 8–8a.

TABLE 26. MEASUREMENTS OF *PROPTYCHITOIDES DECIPIENS* SPATH FROM THE *SUBCOLUMBITES* FAUNAS OF ALBANIA AND CHIOS.

	D	W	H	U	W/D	H/D	U/D
1.	178.0	50.0	85.0	37.0	28.1	47.8	20.8
2.	153.0	45.00	75.00	35.0	29.4	49.0	22.9
3.	81.2	?	42.0	11.1	?	51.7	13.7
4.	79.0?	24.0	45.8	7.0	30.4?	57.9?	8.9?
5.	61.4	18.6?	33.1	7.7	30.3	53.9	12.5
6.	36.4	?	19.3	5.8	?	53.0	15.9

1. Syntype, *Meekoceras hakki* Arthaber (1911: pl. 22(6), fig. 1a–c), PIUV.
2. Syntype, *Meekoceras hakki* Arthaber (1911: pl. 22(6), fig. 2), PIUV.
3. Lectotype, *Proptychitoides decipiens* Spath [= *Proptychites latifimbriatus* (de Koninck)] Arthaber (1911: pl. 19 (3), figs. 2a–c), PIUV.
4. Holotype, *Proptychites kraffti* Arthaber (1911: pl. 19 (3), figs. 3a–c), PIUV.
5. Holotype, *Proptychites lawrencianus* (de Koninck) mut. *postindica* Renz and Renz (1948: pl. 5, fig. 8, NHMB J13725.
6. *Proptychites balcanicus* Renz and Renz (1948: pl. 5, fig. 9), NHMB J13721.

Much of the difficulty in the interpretation of the species of the genus *Proptychitoides* from Albania has been due to the generally poor preservation of the specimens. Features of surface ornamentation, the suture, and measurements of the standard conch dimensions are seldom clearly preserved. In addition, the described species are represented by one or very few specimens.

The type specimen of *P. decipiens* is refigured here on Plate 8, figures 3, 4. The second specimen of this species illustrated by Arthaber (1911: pl. 19(3), figs. 1a–c) is apparently lost. The independent status of this species and related forms from the Salt Range *Proptychites* is most apparent in the suture with its asymmetrical, phylloid saddles (Fig. 11G–J).

Proptychites kraffti (Arthaber, 1911: pl. 19(3), figs. 3a–c; Plate 8, figures 1, 2 of this report) is merely a slightly more involute member of *P. decipiens* (see Table 26). Arthaber had only three specimens of this species, of which only one is still preserved; there is in addition a single specimen in the British Museum of Natural

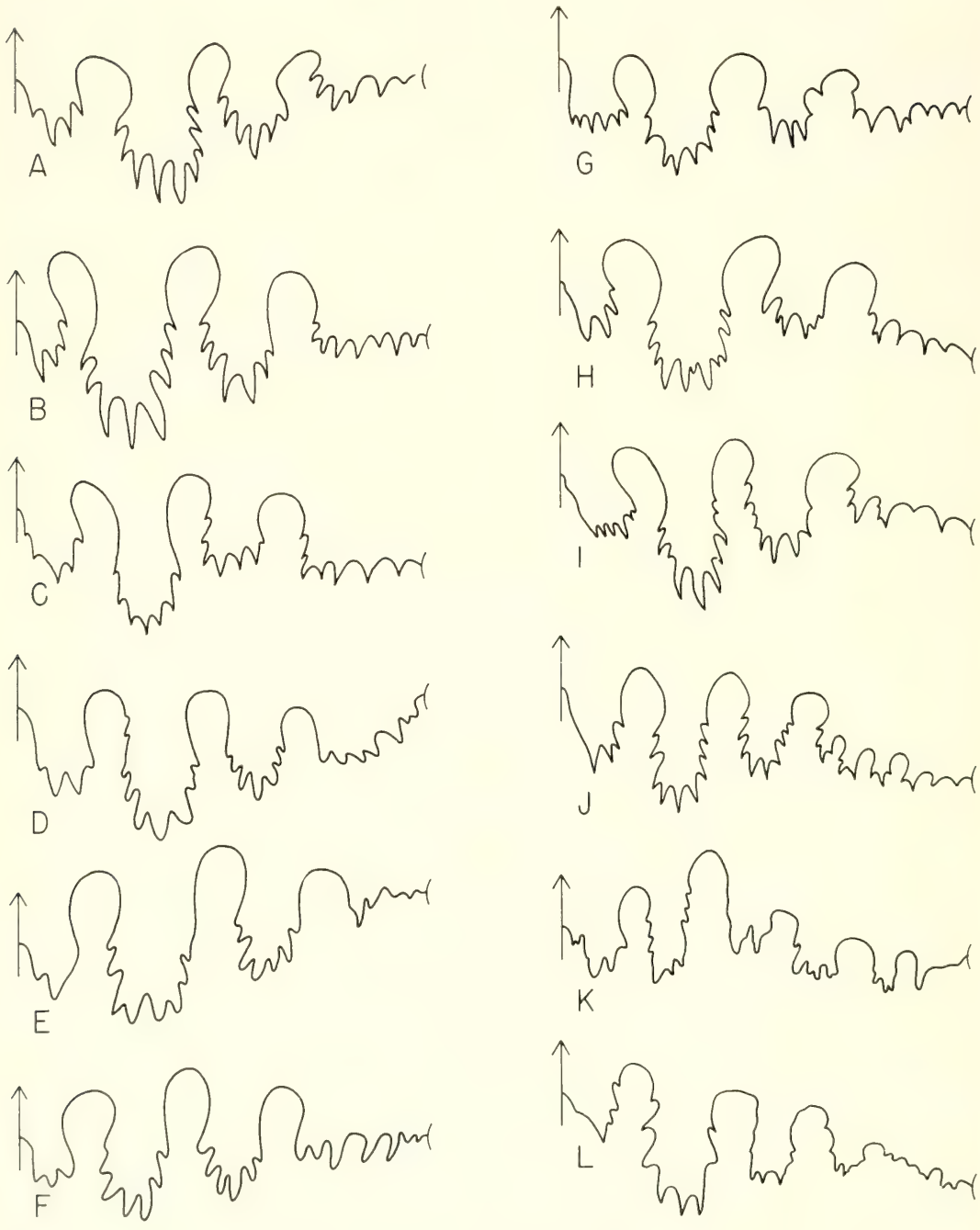

Figure 11. Diagrammatic representation of the sutures of: A–F, *Proptychitoides trigonalis* (Arthaber). A, holotype, at a diameter of 74 mm (Arthaber, 1911: pl. 19(3), fig. 4c; Pl. 9, figs. 3, 4 of this report); B, holotype of *Proptychites bertisci* Arthaber (1911: pl. 19(3), figs. 5a–c; Pl. 9, figs. 1, 2 of this report), at a diameter of 68 mm; C, holotype, *Meekoceras mahomedis* Arthaber (1911: pl. 22(6), figs. 3a–c; Pl. 10, figs. 1, 2 of this report), at a diameter of 90 mm; D, holotype of *Proptychites buxtorfi* Renz and Renz (1948: pl. 7, fig. 1b), at a diameter of approximately 50 mm; E, holotype of

History (Spath, 1934: 174). The small number of available specimens does not permit construction of a meaningful graph. On the basis of the available specimens the differences in the width of the umbilicus between *P. decipiens* and *P. kraffti* are 5 percent or less; from our experience with many other species of these Scythian ammonoids this is well within the range of intraspecific variation seen in most species. The slight difference in the suture, especially in the auxiliary series (Fig. 11G–J), I likewise do not consider of specific importance.

Arthaber's two illustrated specimens of *Proptychites hakki* (1911: pl. 22(6), figs. 1, 2) are very poorly preserved. The holotype (Arthaber, 1911: pl. 22(6), fig. 1) is illustrated here on Plate 12, figure 3. The specimen is preserved only on one side and is slightly crushed. The paratype (Arthaber, 1911, pl. 22(6), fig. 2) is so badly preserved and weathered that only a portion of the phragmocone with the suture exposed offers data of value. The most apparent difference between *P. hakki* and *P. decipiens* is in the relative diameter of the umbilicus. In this regard, however, the two specimens of *P. hakki* are larger by a factor of at least two than all the other specimens from the *Subcolumbites* fauna of Albania and Chios that are here assigned to *P. decipiens*. From the observations that can be made on these specimens, it appears that the relative size of the umbilicus increases as the conch gets larger. The other features of the conch—whorl shape, degree of compression, and suture—are distinctly of the pattern of the type of *P. decipiens*.

The contemporaneous *Subcolumbites* fauna from Chios includes what I consider typical representatives of *P. decipiens*, which was at least partially recognized by Renz and Renz (1948). The papers by Spath (1930, 1934) strangely enough were not known to Renz and Renz (1948). From study of their Chios fauna they came to the conclusion that the Albanian *Proptychites latifimbriatus* (non de Koninck) Arthaber was not conspecific with the Salt Range type of this species, and introduced the new name *Proptychites balcanicus* Renz and Renz (1948: 66). A substitute name for the Albanian species, *P. decipiens*, had already been introduced by Spath in 1930. A second species in the Chios fauna—*Proptychites lawrencianus* (de Koninck) mut. *postindica* Renz and Renz—was recognized, but this is no more than a poorly preserved *P. decipiens* lacking the radial ribs.

Occurrence. *Subcolumbites* fauna of Albania and Chios.

Repository. The following specimens are in the Paleontological Institute, Vienna: holotype, *Proptychitoides decipiens* Spath (= *Proptychites latifimbriatus*,—Arthaber, 1911: pl. 19(3), figs. 2a–c [non de Koninck]); syntype, *Proptychites kraffti* Arthaber, 1911: pl. 19(3), figs. 3a–c (Pl. 4, figs. 1, 2 of this report); holotype *Meekoceras hakki* Arthaber, 1911: pl. 22(6), fig. 1a–c (Pl. 18, fig. 3 of this report); paratype, *Meekoceras hakki* Arthaber, 1911: pl. 22(6), fig. 2. The following specimens are in the

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←

Flemingites pseudorusselli Renz and Renz (1948: pl. 7, fig. 3c), at a diameter of approximately 50 mm; F, type specimen of *Proptychites mohamedis* var. *applanata* Renz and Renz (1948: pl. 6, fig. 3b), at a diameter of approximately 40 mm; G–J, *Proptychitoides decipiens* Spath; G, syntype of *Meekoceras hakki* Arthaber (1911: pl. 22(6), fig. 2), at a diameter of 99 mm; H, syntype of *Meekoceras hakki* Arthaber (1911: pl. 22(6), fig. 1c), at a diameter of 60 mm; I, holotype (= *Proptychites latifimbriatus* non de Koninck, Arthaber (1911: pl. 19(3), fig. 2c), at a diameter of 73 mm, J, syntype *Proptychites kraffti* Arthaber (1911: pl. 19(3), fig. 3c), at a diameter of 65 mm; K, holotype *Procarnites kummeli* Popov (1962: 188, fig. 10), at a diameter of 100 mm; L, holotype of *Proptychites arthaberi* Welter (1922: pl. 2, figs. 1–3), at a diameter of 45 mm.

Specimens of figures A–C, G–J from *Subcolumbites* fauna of Albania, specimens of figures D–F from same fauna on Chios, specimen of figure K from Olenek River region, Siberia, specimen of figure L from Block E, Nifoekoko, Timor.

Natural History Museum, Basel: plesiotype, *Proptychites balcanicus* Renz and Renz (1948: pl. 5, fig. 9) NHMB J13721; unfigured paratypes NHMB 13722; holotype, *Proptychites lawrencianus* (de Koninck) mut. *postindica* Renz and Renz (1948: pl. 5, fig. 8) NHMB J13725.

Proptychitoides trigonalis (Arthaber) Plate 9, figures 1–4; Plate 10, figures 1–4; Plate 11, figure 5; Text-figure 11

Proptychites trigonalis Arthaber, 1911: 225, pl. 19(3), fig. 4; Diener, 1915: 232.
Proptychitoides trigonalis,—Spath, 1934: 174.
Proptychites bertisci Arthaber, 1911: 225, pl. 19(3), fig. 5; Diener, 1915: 231.
Proptychitoides bertisci,—Spath, 1934: 174.
Proptychites obliqueplicatus,—Arthaber (non Waagen), 1911: 226, pl. 20(4), fig. 1.
Proptychitoides (?) *nopcsai* Spath, 1934: 175 (= *Proptychites obliqueplicatus*,—Athaber, non Waagen).
Meekoceras mohamedis Arthaber, 1911: 248, pl. 22(6), fig. 3.
Proptychites mahomedis,—Diener, 1915: 232.
Proptychitoides mahomedis,—Spath, 1934: 175, fig. 51d.
Proptychites mahomedis var. *applanata* Renz and Renz, 1947: 61, 76; Renz and Renz, 1948: 64, pl. 6, figs. 3–3b.
Proptychites ktenasi Renz and Renz, 1947: 61, 76; Renz and Renz, 1948: 65, pl. 6, figs. 1–1b.
Proptychites arthaberi,—Renz and Renz (non Welter) 1947: 61; Renz and Renz, 1948: 65, pl. 7, figs. 4–4b; pl. 5, figs. 7–7b.
Proptychites mistardisi Renz and Renz, 1947: 61, 77; Renz and Renz, 1948: 67, pl. 5, figs. 10–10b.
Proptychites buxtorfi Renz and Renz, 1947: 61, 77; Renz and Renz, 1948: 68, pl. 7, figs. 1–1b.
Koninckites bernoullii Renz and Renz, 1947: 61, 76; Renz and Renz 1948: 58, pl. 5, figs. 5–5a, pl. 6, figs. 2–2a, pl. 7, figs. 2–2a (var.).
Flemingites pseudorusselli Renz and Renz, 1947: 60, 76; Renz and Renz, 1948: 54, pl. 7, figs. 3–3c.
Monophyllites (*Leiophyllites*) *dieneri* Arthaber var. *involuta*,—Renz and Renz, 1947: 61; Renz and Renz, 1948: 75, pl. 5, figs. 1–1b.
Monophyllites (*?Schizophyllites*) *pseudohara* Renz and Renz, 1947: 61, 78; Renz and Renz, 1948: 78, pl. 5, figs. 3–3b.

In contrast to the compressed, more or less involute forms of *Proptychitoides* (e.g., *P. decipiens*) in the *Subcolumbites* fauna of Albania and Chios, there is a more inflated form, with a trigonal whorl section, and generally some form of radial ribs. Arthaber (1911) recognized four species within this "inflated" group, and Renz and Renz (1948) recognized six species and one new variety. The main differences between all these "species" are in the degree of inflation of the whorls and degree of lateral ornamentation. There are thus 10 species plus one variety recognized for this group. Of these, seven species and one variety were established on the basis of a single specimen each, one species was recognized from two specimens, one species on the basis of three specimens, and one species on the basis of five specimens; in summary 18 specimens of this inflated form of *Proptychitoides* gave rise to 10 species and one variety. Thirteen of these specimens are still preserved and were re-examined for this study. The measurements of these specimens are tabulated in Table 27.

The holotype (Plate 9, figures 3, 4) is a poorly preserved phragmocone showing the trace of the umbilical seam for an additional three-quarter volution. The umbilicus is broad and open with steep umbilical walls. The whorl section is trigonal in outline with a narrowly rounded venter. The flanks are slightly crushed but, in spite of this, on the adoral half volution the flanks are slightly concave. This specimen appears to be the inner whorls of what was originally a very large specimen like the holotype of *Proptychites ktenasi* Renz and Renz (1948: pl. 6, fig. 1). Due to poor preservation no surface ornamentation is preserved on the type specimen of *P. trigonalis*.

Proptychitoides bertisci Arthaber (1911: pl. 19(3), fig. 5; Pl. 9, figs. 1, 2 of this report) represents one direction of variation in its very broad, depressed whorl section. Most of the other forms included in *Proptychitoides trigonalis* are variants towards more compressed whorl sections and the development of radial ribs. One

TABLE 27. MEASUREMENTS OF *PROPTYCHITOIDES TRIGONALIS* (ARTHABER) FROM THE *SUBCOLUMBITES* FAUNAS OF ALBANIA AND CHIOS.

No.	D	W	H	U	W/D	H/D	U/D
1.	123.0	45.7?	60.2	24.2	37.2?	48.9	19.7
2.	90.5	30.0	38.8	28.4	33.8	42.9	31.4
3	77.8	?	37.3	21.4	?	47.9	27.5
4.	77.0	35.0	38.5	16.2	45.5	50.0	21.0
5.	76.2	28.5?	35.0	19.1	37.4	45.9	25.1
6.	73.8	38.0?	31.7	21.7	51.5?	42.9	29.4
7.	68.6	?	32.1	16.0	?	46.8	23.3
8.	65.8	?	28.1	19.0	?	42.7	28.9
9.	65.6	17.8	26.7	19.8	27.1	40.7	30.2
10.	61.4	21.7	28.7	14.6	35.3	46.7	23.8
11.	60.6	21.0	26.3	16.0	34.7	43.4	26.4
12.	31.8	10.4	14.8	9.3	32.7	46.5	29.2
13.	30.3	12.6?	13.5	8.4	41.6?	44.6	27.7

1. Holotype, *Proptychites ktenasi* Renz and Renz (1948: pl. 6, fig. 1), NHMB J13715.
2. Lectotype (herein designated), *Meekoceras mahomedis* Arthaber (1911: pl. 22(6), fig. 3), PIUV.
3. Holotype, *Koninckites bernoullii* Renz and Renz (1948: pl. 6, fig. 2), NHMB J13707.
4. Holotype, *Proptychites trigonalis* Arthaber (1911: pl. 19(3), fig. 4a–c), PIUV.
5. Holotype, *Proptychites buxtorfi* Renz and Renz (1948: pl. 7, fig. 1), NHMB J13726.
6. Holotype, *Proptychites bertisci* Arthaber (1911: pl. 19(3), fig. 5), PIUV.
7. Paratype, *Koninckites bernoullii* Renz and Renz (1948: pl. 7, fig. 2), NHMB J13709.
8. Paratype, *Koninckites bernoullii* Renz and Renz (1948: pl. 5, fig. 5), NHMB J13708.
9. Holotype, *Flemingites pseudorusselli* Renz and Renz (1948: pl. 7, fig. 3), NHMB J13698.
10. Plesiotype, *Proptychites arthaberi*,—Renz and Renz (non Welter) (1948: pl. 7, fig. 4), NHMB J13717.
11. Holotype, *Proptychites mohamedis* Arthaber var. *applanata* Renz and Renz (1948: pl. 6, fig. 3), NHMB J13714.
12. Plesiotype, *Proptychites arthaberi*,—Renz and Renz (non Welter) (1948: pl. 5, fig. 7), NHMB J13718.
13. Holotype, *Proptychites mistardisi* Renz and Renz (1948: pl. 5, fig. 10), NHMB J13723.

of the more extreme forms is *Meekoceras mahomedis* (Plate 10, figs. 1, 2). Many of the specimens from the *Subcolumbites* fauna of Chios described as species of *Proptychites*, *Koninckites*, and *Flemingites* as listed in the synonymy are intermediate in degree of whorl inflation and ornamentation between *P. trigonalis* and *P. mahomedis*. The number of available specimens does not allow a statistical analysis of this variation in conch form. Unless one is willing to take note of the large amount of variation potentially possible within many ammonite species where there is an abundance of data, one is left with a name per specimen, as has happened within this group. The pattern of the suture (Fig. 11A–F) and degree of evolution in all these specimens ties them together; on this background the variation in whorl width and ornamentation is much more understandable.

The associated *P. decipiens* differs in its greater involution and pattern of ornamentation. The basic pattern of the suture in these two species remains the same (Fig. 11G–J). The suture and general conch features in the other species of *Proptychitoides* easily distinguish them from *P. trigonalis*.

Occurrence. *Subcolumbites* fauna of Albania and Chios.

Repository. The following specimens are in the Paleontological Institute, University of Vienna: holotype, *P. trigonalis* Arthaber, 1911: pl. 19(3), fig. 4 (Pl. 5, figs. 3, 4 of this report); holotype *P. bertisci* Arthaber, 1911: pl. 19(3), fig. 5 (Pl. 5, figs. 1, 2 of this report); holotype, *P.* (?) *nopcsai* Spath, 1934: 175 (= *Proptychites obliqueplicatus*,—Arthaber, 1911: pl. 20(4), fig. 1, non Waagen (Pl. 6, figs. 3, 4 of this report); holotype, *Meekoceras mahomedis* Arthaber, 1911: pl. 22(6), fig. 3 (Pl. 6, figs. 1, 2 of this report). The following specimens are in the Natural History Museum, Basel: holotype, *Proptychites mohamedis* var. *applanata* Renz and Renz (1948: pl. 6, fig. 3) NHMB J13714; unfigured paratypes NHMB J13835; holotype, *Proptychites ktenasi* Renz and Renz (1948, pl. 6, fig. 1) NHMB J13715; unfigured paratype NHMB J13716; plesiotypes, *Proptychites arthaberi*,—Renz and Renz (1948: pl. 5, fig. 7) NHMB J13718, (pl. 7, fig. 4) NHMB J13717; unfigured paratypes from Maradovuno NHMB J13719, from Kephalovuno NHMB J13720; holotype, *Proptychites mistardisi* Renz and Renz (1948: pl. 5, fig. 10) NHMB J13723; unfigured paratypes NHMB J13724; holotype *Proptychites buxtorfi* Renz and Renz (1948: pl. 7, fig. 1) NHMB J13726; holotype, *Koninckites bernoullii* Renz and Renz (1948: pl. 6,

fig. 2) NHMB J13707; paratypes (pl. 5, fig. 5) NHMB J13708, (pl. 7, fig. 2) NHMB J13709; holotype *Flemingites pseudorusselli* Renz and Renz (1948: pl. 7, fig. 3) NHMB J13698; unfigured paratype NHMB J13699; figured specimen *Monophyllites* (*Leiophyllites*) *dieneri* var. *involuta* Renz and Renz (1948: pl. 5, fig. 1) NHMB J13747; unfigured paratype NHMB J13748; holotype, *Monophyllites* (*Schizophyllites*) *pseudohara* Renz and Renz (1948: pl. 5, fig. 3) NHMB J13763.

Proptychitoides arthaberi (Welter)
Plate 25, figures 1, 2; Text-figure 11

Proptychites arthaberi Welter, 1922: 102, pls. 156(27), figs. 1–4; Kutassy, 1933: 625.
Proptychitoides arthaberi,—Spath, 1934: 177; Kummel, 1961: 525.

This species is of the general conch form of *Proptychitoides trigonalis*. Welter's type and only specimen is well preserved but incomplete; the illustration of the complete specimen (Welter, 1922: pl. 156(2), fig. 4) is slightly inaccurate in that the umbilicus is shown too small. The umbilicus is approximately 21 percent the diameter of the conch rather than 18 percent as indicated by Welter's figure. An additional specimen that is of considerable interest, illustrated here on Plate 25, figures 1, 2, is available in the collections of the Geological Institute, Amsterdam. First, it has a suture nearly identical to that of the type specimen illustrated by Welter (Fig. 11L). The whorl section, however, is more inflated and more trigonal in cross-section. Likewise, the whorl sides bear more prominent radial folds. However, the character of the venter, umbilical shoulder and wall, and degree of involution are the same in the two specimens.

Occurrence. Welter's type specimen came from Block E, Nifoekoko, Timor, with the manganese coated fossils. The specimen in the Amsterdam collections has no label but is a manganese coated specimen like those from Block E at Nifoekoko.

Repository. Holotype in the Paleontological Institute, Bonn; two topotypes are in the British Museum (Natural History) C33748–9; the specimen figured here is in the Geological Institute, University of Amsterdam.

Proptychitoides tunglanensis Chao

Proptychitoides tunglanensis Chao, 1959: 80, 245, pl. 20, figs. 11–12, text-fig. 25a.
Proptychitoides compressus Chao, 1959: 80, 246, pl. 20, figs. 9–10, text-fig. 25b.
Proptychitoides ? simplex Chao, 1959: 81, 246, pl. 20, figs. 7–8, text-fig. 25c.

The three species brought together here were each based on single, poorly preserved specimens from three different localities of the *Subcolumbites* fauna in Kwangsi, China. They likewise represent three different growth stages. Chao (1959) made no reference to the differences between his three species. On the basis of the very poor illustrations, the brief and incomplete descriptions, and taking into account the poor preservation, there appears to be little real basis for separating these three forms.

This Kwangsi species is of the general morphological type of *P. decipiens* from Albania and Chios. The available specimens and their poor preservation do not allow more detailed comparison. This species could be conspecific with the Albanian and Chios *P. decipiens* or possibly *P. arthaberi* from Timor. For the moment it is thought best to retain an independent status for these Kwangsi specimens.

Occurrence. The holotype of *P. tunglanensis* came from the *Subcolumbites* fauna on the western side of Chashanao between Tunglan and Hochich districts (Chao collection 610); the holotype of *P. compressus* came from a limestone block in the Lolou village in the Linglo district, associated with *Procarnites kokeni* (Chao collection 542b); the holotype of *P. simplex* came from the *Subcolumbites* fauna 1.5 km north of Yali in the Fengshan district (Chao collection 546), all in Kwangsi, China.

Proptychitoides kummeli (Popov)
Text-figure 11

Procarnites kummeli Popov, 1962a: 187, pl. 2, fig. 5.

This species has the general conch architecture of *P. arthaberi* and *P. trigonalis*. Its suture is very much like that of the Timor *P. arthaberi* (Fig. 11K) and not like that of any known species of *Procarnites*.

Occurrence. From along the Nikabit River in the Olenek River region, Siberia. Popov (1961: 177, 188) lists the specimens, with questions, as having come from his *Olenekites* Zone.

Genus *Procarnites* Arthaber, 1911
Type species, *Parapopanoceras kokeni* Arthaber, 1908

Procarnites kokeni (Arthaber)
Plate 11, figures 1–4; Plate 12, figures 1, 2; Plate 13, figures 1–8; Text-figures 12, 13

Parapopanoceras kokeni Arthaber, 1908: 259, pl. 11(1), figs. 1a–c, 2a, b.

Hedenstroemia sp. Arthaber, 1908: 284, pl. 3, fig. 2.

Procarnites kokeni (Arthaber) 1911: 215, pl. 17(1), figs. 16, 17, pl. 18(2), figs. 1–5; Diener, 1915: 228; Diener, 1917: 167; C. Renz, 1928: 155; Renz and Renz, 1947: 61; Renz and Renz, 1948: 81, pl. 8, figs. 5, 6–6a, 7–7a, 8–8a, 9–9a, pl. 9, figs. 2–2a; Kummel, 1966: 390, pl. 2, figs. 10–13; Kummel, 1968b: 493, pl. 1, fig. 16.

Procarnites kokeni var. *evoluta* Renz and Renz, 1947: 61; Renz and Renz, 1948: 82, pl. 9, figs. 1–1a.

Procarnites kokeni var. *panteleimonensis* Renz and Renz, 1947: 61, 78; Renz and Renz, 1948: 82, pl. 8, figs. 3–3a, pl. 9, figs. 3–3a.

Procarnites acutus Spath, 1934: 183, pl. 5, figs. 4a, b (= *Hedenstroemia* sp. Arthaber, 1908: 284, pl. 3, fig. 2); Chao, 1959: 89, 255, pl. 32, figs. 8, 9, pl. 33, figs. 1–8.

Procarnites skanderbegis Arthaber, 1911: 216, pl. 18(2), figs. 6, 7; Diener, 1915: 229; C. Renz, 1928: 155; Renz and Renz, 1947: 61; Renz and Renz, 1948: 82, pl. 8, figs. 4–4a.

Procarnites andrusovi (Bajarunas, 1936: nomen nudum) Kiparisova, 1947: 132, pl. 28, figs. 2–4, text-figs. 11–13; Astakhova, 1960b: 149.

Procarnites oxynostus Chao, 1959: 88, 254, pl. 32, figs. 1–7, 10–12, text-fig. 28a–d.

Species of *Procarnites* have been differentiated on the basis of the suture, the degree of inflation of the conch, the nature of the venter, and to some extent on the ornamentation. Much of the misconception that has existed about this species has been due directly to the relatively poor preservation and to the manner of treatment of this material.

The types of *Procarnites kokeni* (Arthaber) are two small, immature specimens, refigured here on Plate 13, figures 1–4. Only one side of either of these specimens is preserved. Noteworthy of the smaller of these two specimens are the broadly arched lateral areas and the round umbilical shoulders. The larger specimen has broader lateral areas and abruptly rounded umbilical shoulders and nearly vertical umbilical walls.

In his monograph on the Kčira, Albania, fauna Arthaber (1911) stated he had 45 specimens for study, and he illustrated six of these. Unfortunately, only three of the illustrated specimens are still available, and these are refigured here. Arthaber did not give measurements of any of his specimens.

In addition to *Procarnites kokeni*, Arthaber (1911) recognized one additional species, *P. skanderbegis*. For this species he records eight specimens of which the two illustrated types are available for study. This species was differentiated on the basis of suture, degree of conch inflation, and ornamentation. In regards to the suture it was the absence of minor adventitious elements in the ventral lobe to which Arthaber pointed. The modification and development of the suture in the ventral region progressively change with growth, and comparing the suture of *P. skanderbegis* with that of *P. kokeni* at a comparable growth stage shows that they differ in only the smallest details (Fig. 12A–C, E, F).

Assessment of the significance of conch shape and ornamentation was not possible until the discovery of the *Subcolumbites* fauna of Chios which yielded a large number of specimens of *Procarnites*. On Table

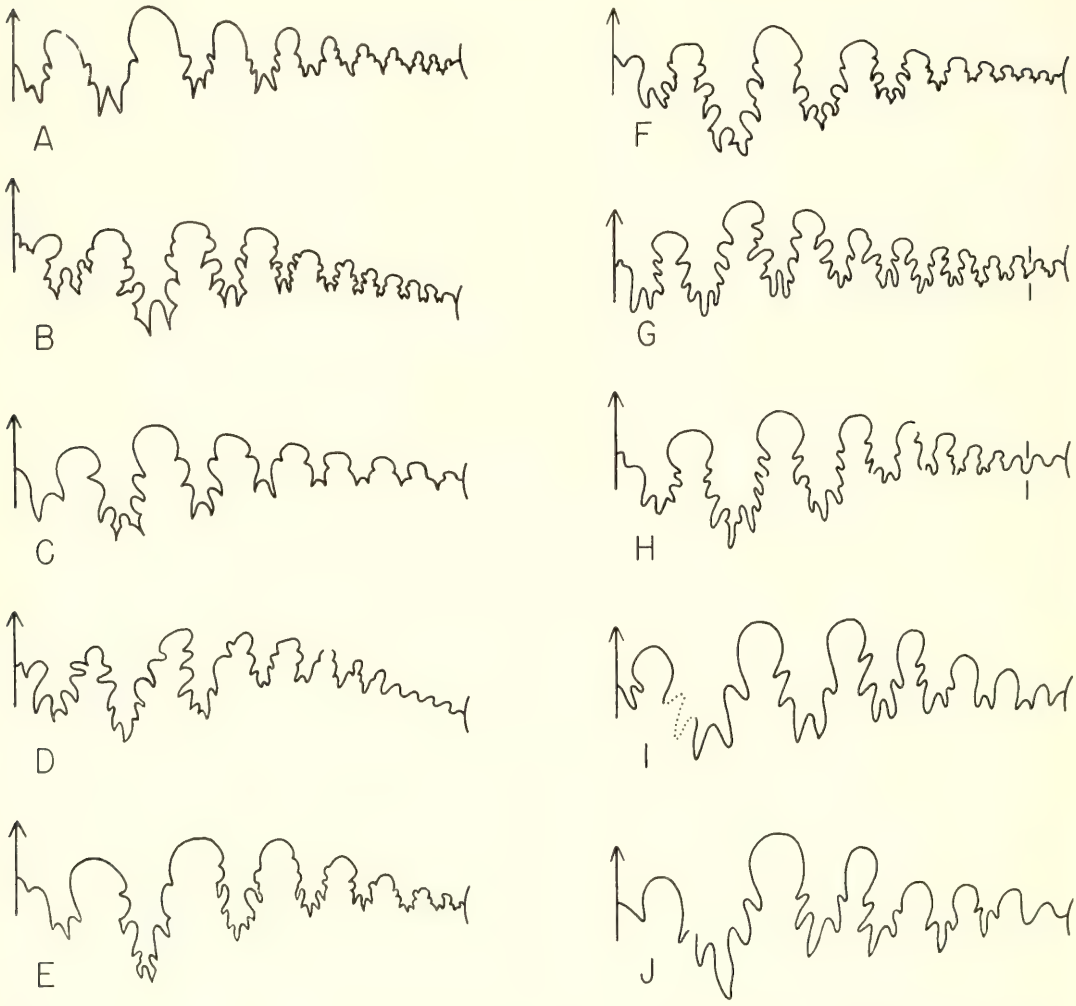
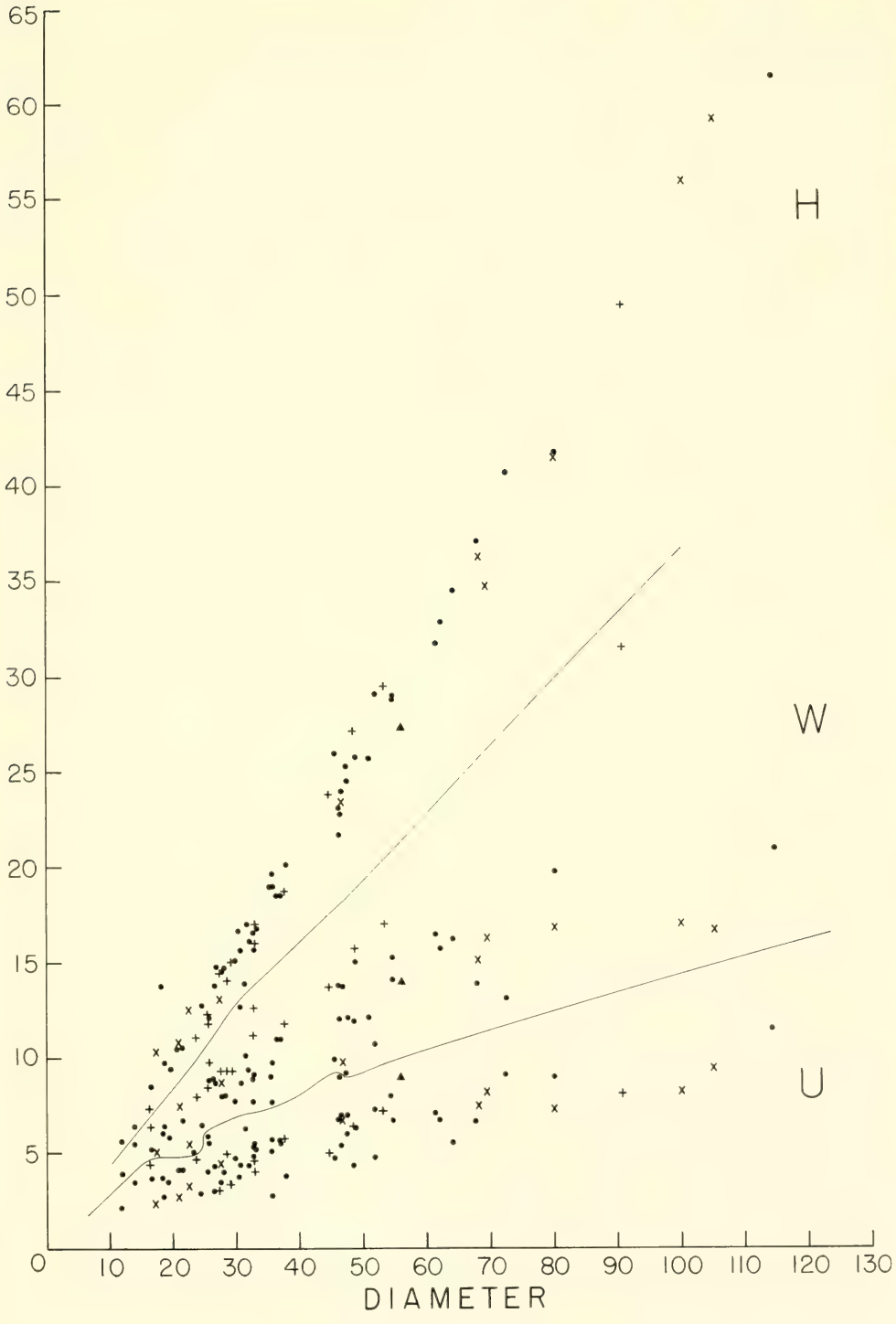


Figure 12. Diagrammatic representation of the sutures of *Procarnites kokeni* (Arthaber), *Procarnites immaturus* (Kiparisova), and *Procarnites lolouensis* (Chao). A–G, *Procarnites kokeni*; A, lectotype (Arthaber, 1908: pl. 11(1), fig. 1c), at a diameter of 33 mm; B, plesiotype (Arthaber, 1911: pl. 18(2), fig. 3), at a diameter of 34 mm; C, plesiotype (Arthaber, 1911: pl. 18(2), fig. 2c), at a diameter of about 21 mm; D, holotype of *Procarnites oxynostus* Chao (1959: fig. 28a), at a diameter of approximately 80 mm; E, paralectotype of *Procarnites skanderbegis* Arthaber (1911: pl. 18(2), fig. 6c), at a diameter of 50 mm; F, lectotype of *Procarnites skanderbegis* Arthaber (1911: pl. 18(2), fig. 7c), at a diameter of 55 mm; G, syntype of *Procarnites andrusovi* Kiparisova (1947: 132, fig. 12), at a diameter of approximately 50 mm; H, holotype of *Megaphyllites immaturus* Kiparisova (1947: 130, fig. 8), at a diameter of approximately 40 mm; I, J, *Digitophyllites lolouensis* Chao (1959, figs. 29a, b), both sutures from whorl height of approximately 10 mm.

Specimens of Figures A–C, E, F from *Subcolumbites* fauna of Albania, of figure G, from upper Scythian of the Mangyshlak Peninsula, D, I, J, from *Subcolumbites* Zone of Kwangsi, China, and H, from *Subcolumbites* fauna of the Primorye Region.

→

Figure 13. Variation in the width (W) and height (H) of whorls, and umbilical diameter (U) of *Procarnites kokeni* (Arthaber). Specimens from Albania and Chios are marked with a dot, those of *Procarnites skanderbegis* with a cross, specimen 69 from the Mangyshlak Peninsula with a triangle, and specimens 64–68 and 70–74 from Kwangsi, China, with an X. The data on this graph are from Table 28.


65
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110
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130
DIAMETER
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U

TABLE 28. MEASUREMENTS OF *PROCARNITES KOKENI* (ARTHABER) FROM THE *SUBCOLUMBITES* FAUNAS OF ALBANIA AND CHIOS. SPECIMENS 1–63: THOSE IDENTIFIED BY ARTHABER AND BY RENZ AND RENZ AS *P. KOKENI* MARKED WITH A DOT, THOSE AS *P. SKANDERBEGIS* WITH A CROSS. SPECIMENS 64–74 MARKED BY AN X; SPECIMEN 69 IS FROM SOUTHERN U.S.S.R., SPECIMENS 64–68, 70–74 ARE FROM KWANGSI, CHINA.

	D	W	H	U	W/D	H/D	U/D		D	W	H	U	W/D	H/D	U/D
1.	114.2	21.0?	61.5	11.6	18.4?	53.9	10.2	38.	31.9	9.3	17.0	4.4	29.2	53.3	13.8
2.	90.5?	31.5?	49.5?	8.2	34.8?	54.7?	9.1?	39.	31.2	10.1	13.9	6.3	32.4	44.6	20.2
3.	80.0	19.7	41.6?	9.0?	24.6	52.0?	11.3?	40.	30.7	8.6	15.6	4.4	28.0	50.8	14.3
4.	72.2	13.1	40.6	9.2	18.1	56.2	12.7	41.	30.3	12.6	16.7	3.8	41.6	55.1	12.5
5.	67.7	13.9	37.2	6.8	20.5	54.9	10.0	42.	29.9	7.7	15.2	4.7	25.8	50.8	15.7
6.	64.0	16.2	34.5	5.6	25.3	53.9	8.8	43.	29.1	9.3	15.0	3.3	31.9	51.5	11.3
7.	62.0	15.7?	32.8	6.8	25.3?	52.9	10.9	44.	28.3	9.3	14.0	5.0	32.9	49.5	17.7
8.	61.1	16.5	31.7	7.1	27.0	51.9	11.6	45.	28.0	8.0	14.7	4.0	28.6	52.5	14.3
9.	54.5	15.2	28.8	6.7	27.9	52.8	12.3	46.	27.8	8.0	14.6	3.5	28.8	52.5	12.6
10.	54.5	14.1	28.9	8.0	25.9	53.0	14.7	47.	27.3	9.3	14.4	3.0	34.1	52.7	10.9
11.	53.0?	17.0?	29.5	6.9	32.1?	55.7?	13.0?	48.	26.8	8.6	14.8	4.3	32.1	55.2	16.0
12.	51.8	10.7	29.0	4.7	20.7	56.0	9.1	49.	26.2	8.9	13.8	3.0	33.9	52.7	11.5
13.	50.8	12.1	25.6	7.3	23.8	50.4	14.4	50.	25.8	8.8	12.1	5.6	34.1	46.9	21.7
14.	48.7	15.0?	25.8	6.3	30.8?	52.9	12.9	51.	25.5	9.7	12.3	4.0?	38.0	48.2	15.7?
15.	48.4	15.6	27.2	4.8	32.2	56.2	9.9	52.	25.3	8.5	11.7	5.9	33.6	46.2	23.3
16.	48.4	11.9	27.2	4.4	24.6	56.2	9.1	53.	24.5	6.4	12.7	2.8	26.1	51.8	11.4
17.	47.3	12.1	24.5	7.0?	25.6	51.8	14.8?	54.	23.6	8.0	11.0	4.7	33.9	46.6	19.9
18.	47.2	9.2	25.2	6.0	19.5	53.4	12.7	55.	21.6	6.6	10.5	4.1	30.6	48.6	18.9
19.	46.5	13.7?	24.0	5.4	29.5?	51.6	11.6	56.	20.8?	?	10.4	4.2	?	50.0	20.2
20.	46.4	12.0	22.8	7.0	25.9	49.1	15.1	57.	19.3	5.8	9.5	3.5	30.1	49.2	18.1
21.	46.2	?	21.7	9.0	?	46.9	19.5	58.	18.6	6.4	9.8	2.7	34.4	52.7	14.5
22.	46.1	13.8	23.1	6.8	29.9	50.1	14.8	59.	18.2	6.0	13.8	3.7	32.9	75.8	20.3
23.	45.4	9.9	26.0	4.7	21.8	57.3	10.4	60.	16.8	5.2?	8.5	3.6	30.9	50.6	21.4
24.	44.5	13.7	23.8	5.0	30.8	53.5	11.2	61.	16.1	6.4	7.2	4.3	39.8	44.7	26.7
25.	37.7	?	20.1	3.8	?	53.3	10.1	62.	14.0	5.5	6.3	3.5	39.3	45.0	25.0
26.	37.2	11.6	18.8	5.7?	31.2	50.5	15.3?	63.	12.0	3.9	5.7	2.1	32.5	47.5	17.5
27.	36.8	11.0	18.6	5.5	29.8	50.5	14.9	64.	105.0	16.7	59.2	9.4	16.0	56.0	8.9
28.	36.5	11.0	18.5	5.6	30.1	50.7	15.3	65.	100.0?	17.0	56.0?	8.2	17.0	56.0	8.2
29.	35.7	7.7	19.6	5.1	21.6	54.9	14.3	66.	80.0	16.8	41.5	7.3	20.0	52.0	9.0
30.	35.6	9.7	19.0?	5.7?	27.2	53.4?	16.0?	67.	69.2	16.2	33.6	8.2	16.6	48.0	12.0
31.	35.4	9.0	19.0	2.8	25.4	53.7	7.9	68.	68.0	15.1	36.2	7.5	22.2	52.0	10.0
32.	33.0	?	16.8	5.2	?	50.9	15.8	69.	56.0	14.0	27.4	9.0			
33.	32.8	12.5	17.0	4.1	38.1	51.8	12.5	70.	46.6	9.7	23.5	6.8	20.0	50.0	14.6
34.	32.8	9.2	15.6	5.3	28.0	47.6	16.2	71.	27.4	8.6	13.0	4.5	21.2	47.8	16.0

1. Plesiotype (Arthaber, 1911: pl. 18(2), figs. 5a, b), PIUV.
2. Syntype, *P. skanderbegis* Arthaber (1911: pl. 18(2), figs. 7a, b), PIUV.
3, 8, 9, 12, 16, 18, 23, 27, 29–31, 35, 45, 46, 49, 53, 58, 59, 62, 63. Unfigured specimens, *P. kokeni* Maradovuno, Chios, NHMB J13774–13779.
4. Plesiotype,—Renz and Renz (1948: pl. 8, fig. 6), NHMB J13769.
5. Plesiotype,—Renz and Renz (1948: pl. 8, fig. 7), NHMB J13772.
6. Plesiotype,—Renz and Renz (1948: pl. 8, fig. 9), NHMB J13773.
7. Plesiotype,—Renz and Renz (1948: pl. 8, fig. 8), NHMB J13770.
10, 17, 22, 37. Unfigured paratypes, *P. kokeni* var. *panteleimonensis*, Maradovuno, Chios, NHMB J13786.
11. Syntype, *P. skanderbegis* Arthaber (1911: pl. 18(2), figs. 6a, b), PIUV.
13 Plesiotype,—Renz and Renz (1948: pl. 9, fig. 2), NHMB J13771.
14 Plesiotype (Arthaber, 1911: pl. 17(1), figs. 17a, b), PIUV.
15. Plesiotype, *P. skanderbegis*, Renz and Renz (1948: pl. 8, fig. 4), NHMB J13788.
19. Plesiotype,—Renz and Renz (1948: pl. 8, fig. 5), NHMB J13768.
20, 28, 38, 40, 41, 42, 48, 50, 55, 57, 60. Unfigured paratypes, *P. kokeni* var. *evoluta*, Maradovuno, Chios, NHMB J13782.
21. Syntype, *P. kokeni* var. *panteleimonensis* Renz and Renz (1947: 61, 78; 1948: pl. 9, fig. 3), NHMB J13785.
24, 26, 33, 36, 43, 44, 47, 51, 52, 54, 61. Unfigured specimens, *P. skanderbegis* Maradovuno, Chios, NHMB J13789.
25. Plesiotype (Arthaber, 1911: pl. 17(1), figs. 16a, b), PIUV.
32. Syntype (Arthaber, 1908: pl. 11(1), figs. 1a–c), PIUV.
34. Syntype, *P. kokeni* var. *panteleimonensis* Renz and Renz (1947: 61, 78; 1948: pl. 8, fig. 3), NHMB J13784.
39. Holotype, *P. kokeni* var. *evoluta* Renz and Renz (1947: 61; 1948: pl. 9, fig. 1), NHMB J13781.

TABLE 28. *Continued*

	D	W	H	U	W/D	H/D	U/D		D	W	H	U	W/D	H/D	U/D
35.	32.7	7.7	16.7	5.5	23.5	51.1	16.8	72.	22.6	5.5	12.5	3.2	23.8	53.4	13.2
36.	32.5	11.2	16.0	4.7	34.5	49.2	14.5	73.	21.0	7.5	10.7	2.7	34.0	51.0	13.0
37.	32.2	8.9	16.1	4.8	27.6	50.0	14.9	74.	17.2	5.0	10.4	2.4	27.8	60.0	14.0

56. Syntype (Arthaber, 1908: pl. 11(1), figs. 2a, b), PIUV.
64, 65, 70, 72. *Procarnites acutus*,—Chao (1959: 255–256).
66. Holotype, *P. oxynostus* Chao (1959: 255).
67, 68, 71, 73, 74. Paratypes, *P. oxynostus* Chao (1959: 255).
69. *Procarnites andrusovi* Kiparisova (1947: 132).

28 are the measurements of 44 specimens assigned by Renz and Renz (1948) to *Procarnites kokeni* and 12 specimens these authors assigned to *P. skanderbegis*. These data are plotted on Figure 13. It can readily be seen that no distinction can be made between these two species on whorl height or umbilical diameter. In respect to whorl width the specimens assigned to *P. skanderbegis* tend to be thicker, but there is complete gradation with more compressed forms which had been placed in *P. kokeni*. The plot of Arthaber's two figured types on Figure 13 likewise shows that these are no more than slightly inflated forms which can much better be considered as part of *P. kokeni*.

The ornamentation of the larger of Arthaber's two figured types (Pl. 11, figs. 1, 2) consists of very faint radial folds and slightly accentuated growth lines every millimeter or so. The specimen is not well preserved so the complete pattern of this ornamentation is not known. None of the specimens from Chios assigned by Renz and Renz to *P. skanderbegis* show any ornamentation. Two specimens of *P. kokeni* (Renz and Renz, 1948: pl. 8, figs. 3, 5 and pl. 9, fig. 3) show faint radial ribs or falcoid ribs. The poor state of preservation of the Albanian and Chios *Subcolumbites* fauna is an important factor which does not allow full evaluation of the nature of and variation of the ornamentation patterns. On the basis of the data available, ornamentation does not appear to be a criterion which can be used in this case for species discrimination. Thus the criteria used to distinguish *P. skanderbegis* from *P. kokeni* do not stand up on close examination.

Spath (1934: 183) separated one of Arthaber's varieties of *Procarnites kokeni* as a new species—*P. acutus*. The distinction was made on the basis of an acute to oxynote venter. He (Spath) also mentions a form which he considered transitional with *P. kokeni* from the same Albanian *Subcolumbites* fauna. Examination of the large number of specimens of *P. kokeni* from Chios clearly shows complete gradation from forms with acute venters like Spath's holotype of *P. acutus* (Spath, 1934: pl. 5, figs. 4a, b) to forms with broadly rounded venters. Arthaber insisted on minor aspects of the suture as important distinguishing features. Spath (1934: 183) was not able to see these differences clearly and correctly brought attention to the frequent loss of detail entailed in the grinding necessary to bring out the sutures on these Albanian specimens.

Procarnites andrusovi Bajarunas (Kiparisova, 1947) from the Mangyshlak Peninsula of the Caspian region is clearly conspecific with *P. kokeni*. Kiparisova distinguished her species on the basis of the greater width of the umbilicus and the addition of an adventive element in the ventral lobe. The umbilical width of *P. andrusovi* falls well within the variability in this feature in the population of *P. kokeni* from Chios (Fig. 12G). It has already been pointed out that variations in the ventral lobe are a function of ontogeny.

Unfortunately, the stratigraphic relations of the Mangyshlak Scythian ammonoids described to date are not well known. The data given by Bajarunas (1936) and Kiparisova (1947) are ambiguous. Recent publications on the Triassic strata of Mangyshlak did not discuss *P. andrusovi* but added some additional stratigraphic data (Astakhova, 1960a, b).

Chao (1959) recognized two species of *Procarnites* from Kwangsi, China. He had four specimens he assigned to *P. acutus* Spath and six specimens for which he erected a new species, *P. oxynostus*. The measurements of these forms are plotted on the graph of Figure 13. It can readily be seen that in terms of whorl heights and umbilical diameter these specimens are quite like *P. kokeni* from Chios. In terms of whorl width they are clearly of the compressed variety but yet within the range of variation in this feature in the material of *P. kokeni* from Chios. The minor differences in the suture pointed to by Chao are more likely expressions of poor preservation than any true genetic significance. These Kwangsi specimens are considered to be valid representatives of *Procarnites kokeni*.

This species was reported from Timor by Spath (1934, p. 182) on the basis of two specimens from Nifoekoko (*Prohungarites* fauna) in the British Museum (Natural History). This species is also present in Afghanistan (Kummel, 1968b) and West Pakistan (Kummel, 1966).

Occurrence. *Subcolumbites* faunas of Albania, Chios, Afghanistan, Kwangsi, China (Chao collection 542b), and Timor; from the *Pseudosageceras* Zone of Astakhova (1960b) in the Mangyshlak Peninsula, Caspian region; from the *Prohungarites* fauna, Salt Range, West Pakistan.

Repository. The following specimens are in the Paleontological Institute, Vienna: lectotype (Arthaber, 1908, pl. 11(1), figs. 1a–c); paralectotype (Arthaber, 1908, pl. 11(1), figs. 2a, b); plesiotypes (Arthaber, 1911, pl. 17(1), figs. 16, 17, pl. 18(2), figs. 5, 6, 7). Topotypes, BMNH C22700–05, C22706–24, C22761–2, C22694–9, C34116–7, C22725, C22882. The specimens from Chios are in the Natural History Museum, Basel, and are as follows: plesiotypes *P. kokeni*, Renz and Renz (1948, pl. 8, fig. 5) NHMB J13768, (pl. 8, figs. 6–6a) NHMB J13769, (pl. 8, figs. 7–7a) NHMB J13772, (pl. 8, figs. 8–8a) NHMB J13770, (pl. 8, figs. 9–9a) NHMB J13773, (pl. 9, figs. 2–2a) NHMB J13771; unfigured specimens from Maradovuno NHMB J13774–13779, from Kephalovuno NHMB J13780; var. *panteleimonensis* Renz and Renz (1948, pl. 8, figs. 3–3a) NHMB J13784, (pl. 9, figs. 3–3a) NHMB J13785; unfigured specimens from Maradovuno NHMB J13786, from Kephalovuno NHMB J13787; var. *evoluta* Renz and Renz (1948, pl. 9, figs. 1–1a) NHMB J13781; unfigured specimens from Maradovuno NHMB J13782, from Kephalovuno NHMB J13783; plesiotype *P. skanderbegis*, Renz and Renz (1948, pl. 8, figs. 4–4a) NHMB J13788; unfigured specimens from Maradovuno NHMB J13789, from Kephalovuno NHMB J13790; topotypes MCZ 10021, 10022; specimens from West Pakistan, MCZ 9593–9595; specimens from Kotal-e-Tera, Afghanistan, MCZ 10154, 10155.

Procarnites immaturus (Kiparisova)
Text-figure 12

Megaphyllites immaturus Kiparisova, 1947: 130, pl. 27, figs. 1, 2, text-fig. 8; Kiparisova, 1954: 22, pl. 12, fig. 4; Kiparisova, 1961: 172, pl. 35, figs. 3–5, text-figs. 115–117; Tozer, 1965a: 39.

Procarnites modestus Tozer, 1965a: 38, pl. 1, figs. 1–6, text-fig. 12.

This species can be distinguished on the basis of faint radial constrictions; in all other features it is quite similar to *P. kokeni* (see illustration of suture, Figure 12H). Tozer (1965a) recognized the close resemblance between his *P. modestus* and *P. immaturus* but relied primarily on a slight difference in the umbilical diameter to separate the two species. Considering that

the specimens of *P. modestus* have crushed body chambers and the near identity in the other morphologic features, I can see no justification for separating these species.

Occurrence. *Subcolumbites* fauna, Cape Zhitkov, Primorye Region, Siberia, and Toad Formation, Halfway River area, British Columbia.

Procarnites lolouensis (Chao)
Text-figure 12

Digitophyllites lolouensis Chao, 1950: 5, pl. 1, figs. 4–6; Chao, 1959: 90, 256, pl. 32, figs. 13–19, text-figs. 29a, b.

Chao (1959) recognized that this species was a procarnitid but established a new genus for it because it differed from *Procarnites* in (1) having a wider umbilicus, (2) having a broadly arched venter rather than a narrow or acute one, encompassing a subquadratic whorl section, and (3) having a different suture. In the first place, the umbilicus compares very favorably in diameter to the specimen of *Procarnites kokeni* of comparable size from Chios. Chao gave measurements on four specimens of diameters from 30 to 27 mm; the umbilical diameters ranged from 6.0–4.5 mm. Among the specimens of *Procarnites kokeni* from Chios, those of a diameter of 30.3 to 26.8 mm have a range of diameter of 5–3 mm.

The more inflated, subquadrate whorl is quite distinctive. Finally, a comparison of the sutures of these Kwangsi specimens and those at the same relative conch size is shown on Figure 12I, J. The adventitious elements mentioned by Chao do not appear until a much later stage of growth. All in all I can see no justification for establishing a new genus for this species. Chao's specimens could well be juvenile forms, but they are no more than a more inflated form of *Procarnites* and in this respect differ from *kokeni* and *immaturus*.

Occurrence. *Subcolumbites* fauna, Naliling sections near Lolou village (Chao collections 541a, b, 542b), Kwangsi, China.

Family PARANANNITIDAE Spath, 1930
Genus *Arnautoceltites* Diener, 1916
Type species, *Celtites arnauticus* Arthaber, 1911

This genus is confined to the late Scythian *Prohungarites* Zone where it is represented by five species: *A. mediterraneus* from the *Subcolumbites* fauna of Albania and Chios, *A. bajarunasi* from the late Scythian strata of the Mangyshlak Peninsula, *A. involutus* from the *Subcolumbites* fauna of Kwangsi, China, *A. gracilis* from the *Subcolumbites* fauna of the Primorye Region, and *A. teicherti* from the *Subcolumbites* fauna of Nevada. Of special interest in this group of species is the very large degree of intraspecific variation in the Albanian and Chios *A. mediterraneus*, in contrast to a very limited degree of such variation in *A. teicherti* from Nevada. The other species are represented by very few specimens.

Arnautoceltites mediterraneus (Arthaber)
Plate 6, figures 7–13; Plate 7, figures 5, 6; Text-figure 14

Paranannites mediterraneus Arthaber, 1911: 220, pl. 18(2), fig. 8; Diener, 1915: 216; C. Renz, 1928: 155; Renz and Renz, 1947: 61, 66; Renz and Renz, 1948: 69, pl. 1, figs. 12, 12b, 13, 13a, 17.

Arnautoceltites mediterraneus,—Spath, 1934: 193, pl. 14, figs. 1a–c, text-fig. 59f.

Paranannites mediterraneus Arthaber var. *media* Renz and Renz 1947: 77; Renz and Renz, 1948: 70, pl. 1, figs. 11–11b, 14–14b.

Paranannites chionensis Renz and Renz, 1947: 66, 77; Renz and Renz, 1948: 70, pl. 1, figs. 10–10c.

Paranannites aspenensis Hyatt and Smith var. *europaea* Renz and Renz, 1947: 61; Renz and Renz, 1948: 71, pl. 1, figs. 16–16c.

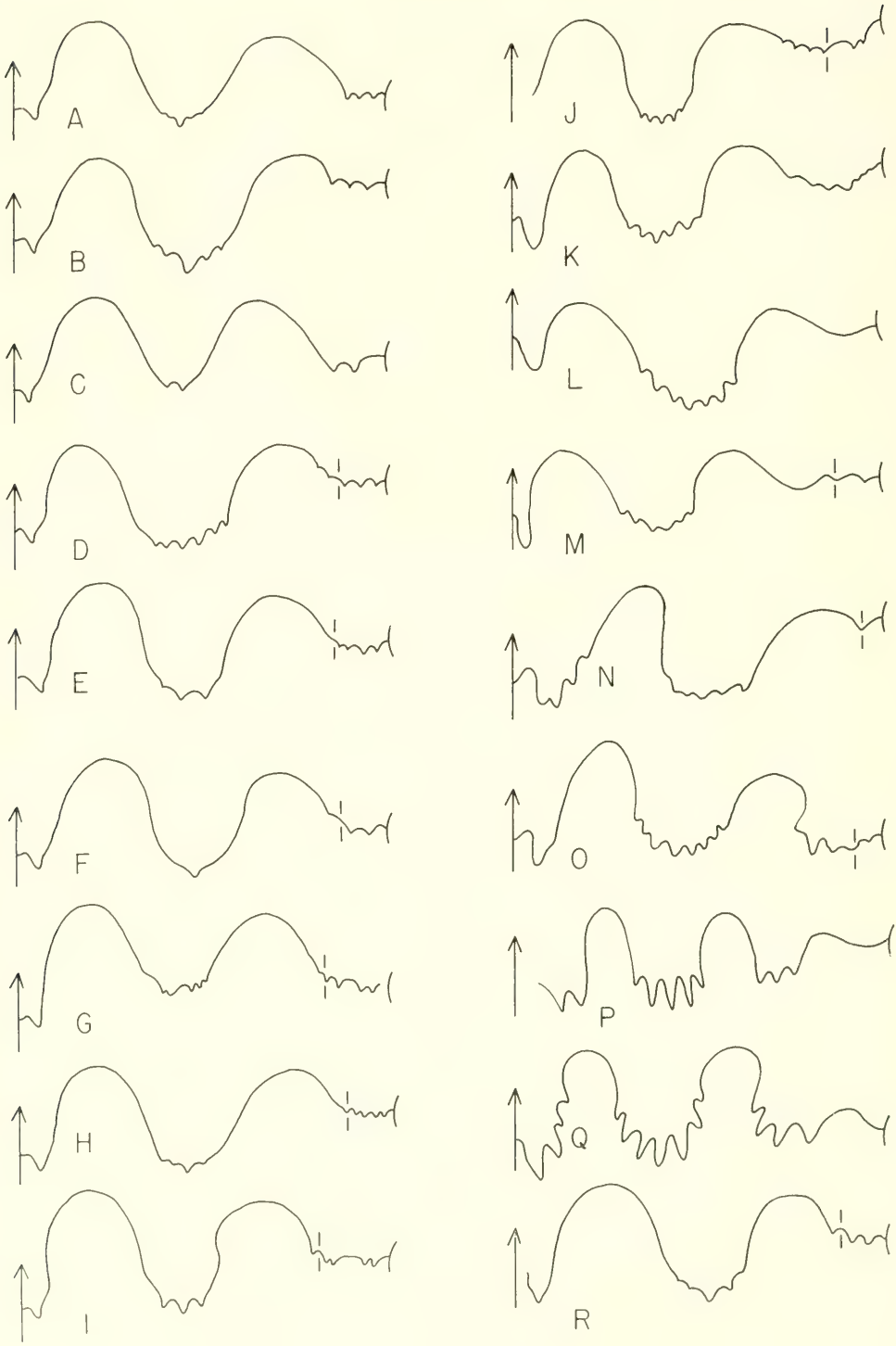
Paranannites compressus Renz and Renz, 1947: 61, 77 (non Smith, 1932: 99, pl. 31, figs. 19–20); Renz and Renz, 1948: 71, pl. 1, fig. 15–15b.

Paranannites chiosensis Kiparisova, 1961: 130 (= *P. compressus* Renz and Renz, 1948, non Smith, 1932).

Celtites arnauticus Arthaber, 1911: 267, pl. 24(8), fig. 7; Diener, 1915: 73; Smith, 1932: 37.

Arnautoceltites arnauticus,—Spath, 1934: 192, pl. 13, figs. 6a–f.

Paragoceras dukagini Arthaber, 1911: 182, 188, 265, pl. 24(8), fig. 6; Diener, 1915: 366; C. Renz, 1928: 155; Kutassy, 1933: 607; Spath,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1934: 199, fig. 60; Kummel, *in* Arkell, et al., 1957: L139, figs. 172, 3; Renz and Renz, 1948: 96.

Nannites herberti,—Arthaber (non Diener), 1908: 274, pl. 11(1), figs. 7a, b; Arthaber, 1911: 220.

A characteristic ammonite of the *Subcolumbites* fauna of Albania is a small form, generally involute, with prosiradiate constrictions. Arthaber (1908, 1911) classified ammonites of this general morphology in four species in four different genera. These species are:

Paranannites mediterraneus Arthaber
Celtites arnauticus Arthaber
Paragoceras dukagini Arthaber
Nannites herberti Diener

The first of the species was based on 5 specimens of which only 2 are preserved; the second species was based on 17 specimens of which only one exists; the last two species were each based on a single specimen and these are still preserved. The basic difference between these species as recognized by Arthaber lay in the suture. *Paranannites mediterraneus* was stated to have a single, serrated, lateral lobe, *Celtites arnauticus* a goniatitic lateral lobe, *Paragoceras dukagini* a particularly unique suture (of which more later), and finally, no suture was available on the specimen assigned to *Nannites herberti*.

The suture of the lectotype of *Paranannites mediterraneus* reproduced by Arthaber (1911: pl. 18(2), fig. 8c) is somewhat poorly executed, but more significant, it is incomplete. A new drawing of the suture of this type specimen is reproduced here on Figure 14J. The principal new datum on the suture is the presence of a broad, shallow, second lateral lobe on the umbilical shoulder and wall.

The goniatitic suture of *Celtites arnauticus* needs verification. The only suture known of this species is that reproduced by Arthaber (1911: pl. 24(8), fig. 7d). It is only by implication that one would believe that this suture is from the figured specimen of Arthaber's plate 24(8), figures 7a–c. However, this specimen is preserved and shown here on Plate 6, figures 12, 13; no sutures are visible on the specimen. Likewise, Spath (1934: 192) did not uncover a suture among the topotypes in the British Museum, and resorted to reproducing Arthaber's data. The hard limestone preservation of the Albanian *Subcolumbites* fauna requires grinding and polishing to expose the suture. It has been demonstrated in this report that the sutures of many of the species described by Arthaber are to a greater or lesser extent distorted and inaccurate representations mainly due to excessive preparation. There is every reason to believe this is the case with the suture of *Celtites arnauticus*. This suggestion is strengthened on consideration of

←

Figure 14. Diagrammatic representation of the sutures of various species of *Arnautoceltites*. A–I, *Arnautoceltites teicherti* n. sp., from Tobin Formation of Nevada; A, at a diameter of 11 mm (MCZ 9617); B, at a diameter of approximately 11 mm (MCZ 9618); C, at a diameter of 10.5 mm (MCZ 9619); D, at a diameter of 9.5 mm (MCZ 9620); E, at a diameter of 9 mm (MCZ 9621); F, at a diameter of 9 mm (MCZ 9622); G, at a diameter of 8.5 mm (MCZ 9623); H, at a diameter of 8.5 mm (MCZ 9624); I, at a diameter of 7 mm (MCZ 9625); J, lectotype of *Paranannites mediterraneus* Arthaber (1911), from *Subcolumbites* fauna, Albania; K, plesiotype of *Paranannites mediterraneus*,—Renz and Renz (1948: pl. 1, fig. 17), at a whorl height of approximately 9 mm, from *Subcolumbites* fauna of Chios (NHMB-J13729); L, syntype of *Paranannites mediterraneus* var. *media* Renz and Renz (1948: pl. 1, fig. 11b), at a diameter of approximately 20 mm, from *Subcolumbites* fauna of Chios (NHMB-J13732); M, holotype of *Paranannites chionensis* Renz and Renz (1948: pl. 1, fig. 10c), at a diameter of approximately 16 mm, from *Subcolumbites* fauna of Chios (NHMB-J13737); N, holotype of *Paranannites compressus* Renz and Renz (1948: pl. 1, fig. 15b), at a diameter of approximately 20 mm, from *Subcolumbites* fauna of Chios (NHMB-J13736); O, holotype of *Paranannites gracilis* Kiparisova (1961: fig. 93), at a diameter of approximately 10 mm; P, holotype of *Paranannites involutus* Chao (1959: fig. 37d), at a whorl height of 9 mm from beds with *Subcolumbites*, Kwangsi, China; Q, holotype of *Paranannites minutus* Chao (1959: fig. 37b), at a whorl height of 10.5 mm, from *Subcolumbites* fauna, Kwangsi, China; R, holotype of *Paragoceras dukagini* Arthaber (1911), at a diameter of approximately 11 mm, from *Subcolumbites* fauna, Albania.

the remaining morphological features of the shell. In this regard, the type specimen of *Celtites arnauticus* differs from the type specimen of *Paranannites mediterraneus* only in being slightly more evolute. It is unfortunate that the sample from the *Subcolumbites* fauna of Albania is so small, but Spath (1934: 192), in commenting on the few topotype specimens of *Celtites arnauticus* and *Paranannites mediterraneus* in the collections of the British Museum, states "there are thin and thick varieties of each." I cannot consider the differences in degree of involution of these two species (specimens) as a distinction warranting separation of the two forms.

The single specimen Arthaber (1908) assigned to *Nannites herberti* is illustrated here on Plate 6, figures 7, 8. It does not preserve a suture but in all other morphological features it is nearly identical to the specimen assigned to *Paranannites mediterraneus.*

Paragoceras dukagini (Arthaber, 1911: 265) was based on a single, poorly preserved specimen (Pl. 7, figs. 5, 6). The conch dimensions, degree of involution, and pattern of constrictions show the specimen to be identical with *A. mediterraneus.* It was primarily on the basis of the unusual suture reproduced by Arthaber (1911: pl. 24(8), fig. 6c) that Spath (1934) and others have accepted the genus. Re-examination of the type specimen shows that the suture has been damaged in preparation, but a new drawing of what is visible is shown on Figure 14R. The suture is that of a typical representation of *A. mediterraneus* and very unlike that reproduced by Arthaber.

The *Subcolumbites* fauna of Chios studied by Renz and Renz (1948) contains 19 specimens which they assigned to four species of *Paranannites* (= *Arnautoceltites*). Of these, however, only six of the figured specimens are sufficiently well preserved and complete to yield significant measurements, which are given on Table 29. Each of these specimens which yielded a suture has denticulated lobes. The specimens assigned to *Paranannites mediterraneus* (Renz and Renz, 1948: pl. 1, figs. 12, 13, 17), *Paranannites mediterraneus* var. *media* (Renz and Renz, 1948: pl. 1, figs. 11, 14), and *Paranannites aspenensis* Hyatt and Smith var. *europaea* (Renz and Renz, 1948: pl. 1, fig. 16) are clearly conspecific with the Albanian type specimen of *Arnautoceltites mediterraneus.* One highly compressed specimen was separated as *Paranannites compressus* (Renz and Renz, 1948: pl. 1, fig. 15) and another specimen intermediate in degree of compression between *compressus* and *mediterraneus* was set aside as *Paranannites chiosensis.* The sutures of these Chios specimens (Fig. 14M) are all essentially the same, differing in minor

TABLE 29. MEASUREMENTS OF *ARNAUTOCELTITES MEDITERRANEUS* (ARTHABER) FROM THE *SUBCOLUMBITES* FAUNAS OF ALBANIA AND CHIOS.

	D	W	H	U	W/D	H/D	U/D
1.	26.1	9.5	10.9	7.6	36.4	41.8	29.1
2.	23.1	?	9.2	7.2	?	39.8	31.2
3.	23.0	7.0?	10.0	3.5	30.4?	43.5	15.2
4.	19.3	10.0	6.6	8.0	51.8	34.2	41.5
5.	18.5	11.0	6.6	6.4	59.5	35.7	34.6
6.	18.0	11.2	6.8	6.5	62.2	37.8	36.1
7.	17.4	11.2	7.0	5.0	64.4	40.2	28.7
8.	17.1	9.7	6.8	6.0	56.7	39.8	35.1
9.	16.5	?	6.4	4.9	?	38.8	29.7
10.	16.0	?	6.1	5.2	?	38.1	32.5
11.	15.6	?	7.3	3.7	?	46.8	23.7

1. Holotype, *Paranannites chionensis* Renz and Renz (1948, pl. 1, fig. 10), NHMB J13737.
2. Plesiotype, *P. mediterraneus* var. *media* Renz and Renz (1948, pl. 1, fig. 11), NHMB J13732.
3. Holotype, *Paranannites compressus* Renz and Renz (1948, pl. 1, fig. 15), NHMB J13736.
4. Lectotype, *Arnautoceltites arnauticus* (Arthaber, 1911, pl. 24(8), fig. 7).
5. Holotype, *Paragoceras dukagini* Arthaber (1911, pl. 24(8), fig. 6).
6. Plesiotype, *Paranannites mediterraneus,*—Renz and Renz (1948, pl. 1, fig. 12), NHMB J13727.
7. Lectotype, *Arnautoceltites mediterraneus* (Arthaber, 1911, pl. 18(2), fig. 8).
8. Plesiotype, *Nannites herberti,*—Arthaber (1908, p. 274, pl. 11(1), fig. 7) (non Diener).
9. Plesiotype, *P. mediterraneus* var. *media* Renz and Renz (1948, pl. 1, fig. 14), NHMB J13733.
10. Paralectotype, *Arnautoceltites mediterraneus* (Arthaber, 1911, p. 220).
11. Plesiotype, *P. aspenensis* var. *europaea* Renz and Renz (1948, pl. 1, fig. 16), NHMB J13735.

Specimens 1–3, 6, 9, 11 are from the *Subcolumbites* fauna of Chios; specimens 4, 5, 7, 8, 10 are from the *Subcolumbites* fauna of Albania.

details. The prosiradiate constrictions are variable in both the number per volution and in the degree of forward projection.

It is indeed unfortunate that the sample available from the *Subcolumbites* fauna of Chios is so limited. However, on the basis that these specimens came from one horizon and locality and were most probably part of a single population unit, and that other species of this population (for example *Isculitoides originis*) show a comparable range in shell variation as between *mediterraneus* and *compressus*, I believe it best to consider all these Chios specimens as members of a highly variable species—*mediterraneus*.

Occurrence. *Subcolumbites* fauna of Albania and Chios.

Repository. The following specimens from Albania are in the Paleontological Institute, University of Vienna: lectotype (Arthaber, 1908: pl. 18(2), fig. 8) and one paralectotype; lectotype of *Celtites arnauticus* Arthaber (1911: pl. 24(8), fig. 7); plesiotype of *Nannites herberti*,—Arthaber (1908: pl. 11, fig. 7) (non Diener); holotype of *Paragoceras dukagini* Arthaber (1911: pl. 24, fig. 6). In addition, the British Museum (Natural History) has some topotype specimens. The following specimens from Chios are in the Natural History Museum of Basel: plesiotype (Renz and Renz, 1948: pl. 1, fig. 12) NHMB J13727, (Renz and Renz, 1948: pl. 1, fig. 13) NHMB J13728, (Renz and Renz, 1948: pl. 1, fig. 17) NHMB J13729; *Paranannites mediterraneus* var. *media* (Renz and Renz, 1948: pl. 1, fig. 11) NHMB J13732, (Renz and Renz, 1948: pl. 1, fig. 14) NHMB J13733; unfigured specimen NHMB J13734; holotype *Paranannites chionensis* Renz and Renz (1948: pl. 1, fig. 10) NHMB J13737; unfigured paratype NHMB J13738; type of *Paranannites aspenensis* Hyatt and Smith var. *europaea* Renz and Renz (1948: pl. 1, fig. 16) NHMB J13735; holotype *Paranannites compressus* Renz and Renz (1948: pl. 1, fig. 15) NHMB J13736; specimen of *Paragoceras dukagini* Arthaber (Renz and Renz, 1948: p. 96) NHMB J13838; topotypes from Chios MCZ 10115.

Arnautoceltites bajarunasi (Astakhova)

Nannites bajarunasi Astakhova, 1960a: 145, pl. 34, figs. 2, 3; Astakhova, 1960b: 150.

This species has been based on two small specimens that morphologically are not too different in appearance from the Albanian *A. mediterraneus*. There appears to be a tendency on the outer volution for the whorls to be vaulted. The most significant characteristic is the goniatitic suture with a large, smooth lateral lobe followed by a much smaller lobe on the umbilical shoulder.

Occurrence. In *Stacheites* Zone of Astakhova (1960a, b) on the Mangyshlak Peninsula, said to be associated with *Stacheites prionoides*.

Arnautoceltites involutus Chao
Text-figure 14

Paranannites involutus Chao, 1959: 113, 285, pl. 24, figs. 13–15, 18, 20, 25, text-fig. 37d.
Paranannites minutus Chao, 1959: 114, 286, pl. 24, figs. 16, 17, text-fig. 37b.

A very involute species most comparable to (and possibly conspecific with) *Paranannites gracilis* Kiparisova from the Primorye Region. The suture (Fig. 14P, Q) has a distinct second lateral lobe. Data on this species are very incomplete.

Occurrence. *Subcolumbites* fauna, Kwangsi, China (Chao collection 546).

Arnautoceltites gracilis (Kiparisova)
Text-figure 14

Paranannites gracilis Kiparisova, 1947: 140, pl. 28, fig. 1, text-fig. 25; Kiparisova and Krishtofovich, 1954: 21, pl. 12, fig. 1; Kiparisova, 1961: 125, pl. 28, figs. 3, 4, text-figs. 92, 93.
Paranannites minor Kiparisova, 1961: 129, pl. 28, figs. 1, 2, text-fig. 98.

An involute species quite similar to *A. involutus* Chao and possibly even conspecific with it. The suture (Fig. 14O) is different in that the second lateral lobe occupies all of the umbilical shoulder and

TABLE 30. MEASUREMENTS OF *ARNAUTOCELTITES TEICHERTI* N. SP. FROM THE TOBIN FORMATION OF NEVADA.

	D	W	H	U	W/D	H/D	U/D
1.	21.3	12.1	8.2	6.2	56.8	38.4	29.1
2.	21.3	11.3	?	?	53.5	?	?
3.	20.2	12.1	8.7	4.8	59.4	43.0	23.2
4.	20.2	10.3	7.7	5.7	50.9	38.1	28.2
5	20.0	11.9	9.6	4.9	59.5	48.0	24.5
6.	19.7	12.4	7.7	5.9	62.9	39.0	29.9
7.	19.7	11.3	7.6	5.7	52.2	38.6	28.9
8.	19.6?	10.4	7.6	6.4	53.0?	38.7	32.6
9.	19.0	11.0	8.0	5.2	57.8	42.1	27.3
10.	18.8	11.2	8.0	5.0	59.5	42.5	26.5
11.	18.8	10.8	6.8	5.7	57.4	36.1	30.3
12.	18.1	9.6	7.3	5.3	53.0	40.3	29.2
13.	17.7	9.6	7.8	4.8	54.2	44.0	27.0
14.	17.5	11.7	7.4	3.8	66.8	42.2	21.7
15.	17.5	10.2	6.7	4.6	58.2	38.2	26.2
16.	16.5	9.2	6.6	4.3	55.7	40.0	26.6
17.	16.4	10.3	6.5	4.2	62.8	33.5	25.6
18.	16.2	9.5	6.7	4.3	58.6	41.3	26.5
19.	16.0	9.1?	7.1	4.0	56.8?	44.3	25.0
20.	15.6	9.4	6.7	4.1	60.2	42.9	26.2
21.	15.5	9.0	6.5	4.1	58.0	41.9	26.4
22.	15.3	9.0	6.5	4.1	58.8	42.4	26.7
23.	15.0	9.1	6.0	3.6	60.6	40.0	24.0
24.	14.8	9.3	6.0	3.6	63.5	40.5	24.3
25.	14.8	8.7	6.9	3.5?	56.0	46.6	23.6?
26.	14.6	9.0	5.4	3.7	61.6	36.9	25.3
27.	14.5	8.5	5.9	3.5	58.6	40.6	24.1
28.	14.4	8.2	6.1	3.1	56.9	42.3	21.5
29.	14.3	8.5	5.8	3.8	59.4	40.5	26.5
30.	14.1	9.4?	5.7	3.5	66.6?	40.4	24.8
31.	13.8	9.2	6.1	4.0	66.6	44.2	28.9
32.	13.3	8.8	5.7	3.3	66.1	42.8	24.8
33.	12.6	7.7	5.6	3.0	61.1	44.4	23.8
34.	11.1	7.6	4.6	3.0	68.4	41.4	27.0
35.	10.8	7.3	4.8	2.3	67.5	44.4	21.2
36.	9.6	6.5?	4.4	2.2	67.7	45.8?	22.9
37.	9.0	6.2	4.0	2.2	68.8	44.4	24.4
38.	8.4	6.4	4.2	1.2	76.1	50.0	14.2

3. Paratype, MCZ 9460 (Pl. 31, figs. 6, 7).
4. Paratype, MCZ 9457 (Pl. 31, figs. 1, 2).
7. Paratype, MCZ 9458 (Pl. 31, figs. 3, 4).
8. Paratype, MCZ 9462 (Pl. 31, figs. 13, 14).
9. Paratype, MCZ 9461 (Pl. 31, figs. 9, 10).
12. Paratype, MCZ 9459 (Pl. 31, fig. 5).

All other specimens are unfigured paratypes (MCZ 9490).

wall. Both this species and the Kwangsi *A. involutus* differ from *A. mediterraneus* and *A. teicherti* in the suture and degree of involution of the conch.

Occurrence. *Subcolumbites* fauna, Cape Zhitkov, Primorye Region, Siberia.

Arnautoceltites teicherti n. sp.

Plate 31, figures 1–7, 9–14; Text-figures 14, 15

The *Subcolumbites* fauna from the Tobin Formation of Nevada has yielded approximately 75 specimens of this new species, of which 38 are sufficiently well preserved and complete to obtain measurements. The measurements are given on Table 30 and the plot of these data shown on the graph of Figure 15.

The basic morphology of the shell, that is, degree of involution, whorl cross-section, pattern of constrictions, etc., is very much like that of the Albanian *Arnautoceltites mediterraneus*. It is only in the suture that a small but subtle difference between these species can be recognized. On Figure 14 are 9 sutures of *A. teicherti*. It is readily seen that there is a high degree of variability. This is especially noted in the shape and pattern of denticulation of the first lateral lobe. The second lateral lobe, lying on the umbilical shoulder and wall, is likewise variable but in all cases more pronounced than in the Albanian and Chios representations of *A. mediterraneus*. It is primarily on this feature that I conclude the two species are specifically distinct but closely related. These two species are quite distinct from the other species of *Arnautoceltites* so far recorded.

Occurrence. Lower part Tobin Formation, U.S.G.S. Mesozoic locality M2562, Pershing County, Nevada; south tip of Tobin Range, Cain Mountain 1:62,500 quad., center NW ¼ sec. 9, T. 26N, R. 39E, 5,500 ft. S, 27.5 ft. W from elevation point 5088 on range crest.

Repository. Holotype, MCZ 9457 (Pl. 31, figs. 1, 2); paratypes, MCZ 9458 (Pl. 31, figs. 3, 4), MCZ 9459 (Pl. 31, fig. 5), MCZ 9460 (Pl. 31, figs. 6, 7), MCZ 9461 (Pl. 31, figs. 9, 10), MCZ 9462 (Pl. 31, figs. 13, 14); suture specimens Figures 31A–I, MCZ 9617–9625; unfigured paratypes MCZ 9490.

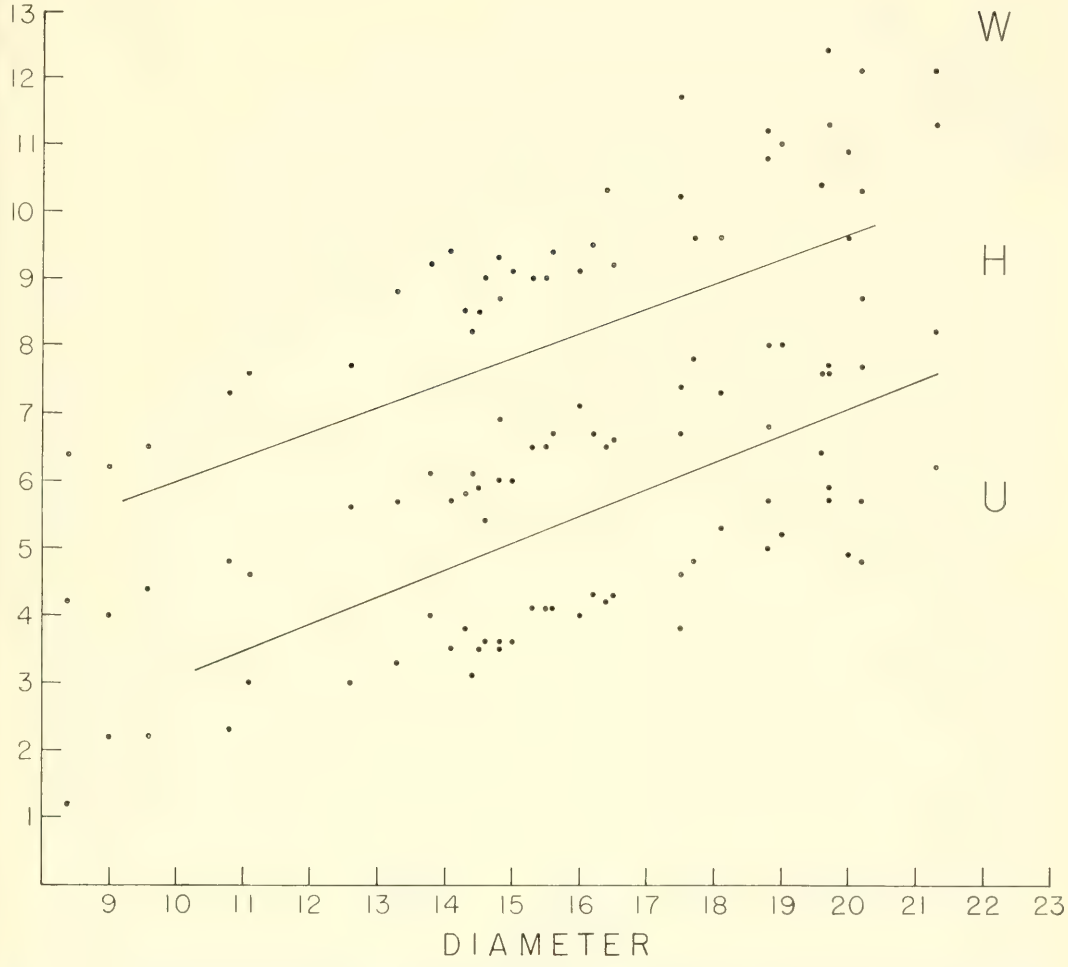


Figure 15. Variation in whorl height (H), whorl width (W) and umbilical diameter (U) in *Arnautoceltites teicherti* n. sp. from the Tobin Formation of Nevada. The data on this graph are from Table 30.

Genus *Prosphingites* Mojsisovics, 1886
Type species, *Prosphingites czekanowskii* Mojsisovics, 1886

Prosphingites has until the last few years been considered mainly a late Scythian genus (*Subcolumbites—Prohungarites* Zone). The type species, *P. czekanowskii* Mojsisovics (1886: 64, pl. 15, figs. 10–12) came from the *Olenekites* fauna of northern Siberia, of upper Scythian age. Hyatt and Smith (1905: 72, pl. 7, figs. 1–4) later described *P. austini* from the *Meekoceras* fauna of southern California. Spath (1934) was uncertain as to the status of *P. austini* and in his interpretation of the zonal range of the genus tended to place more reliance on the type species from the Olenek beds and *P. spathi* (Frebold, 1930) from the so-called Fish beds of Spitsbergen, which he considered to be late Scythian in age, more or less contemporaneous with the Olenek fauna. Both Kummel (1961) and Tozer (1961a) have presented convincing arguments that this particular Spitsbergen horizon is mid-Scythian (*Owenites* Zone) in age. In recent years a number of new

species of *Prosphingites* have been described from Chios (Renz and Renz, 1948), Kwangsi, China (Chao, 1959), eastern Siberia (Kiparisova, 1961), Arctic Canada (Tozer, 1961a), and western United States (Kummel and Steele, 1962).

From the mid-Scythian, *Owenites* Zone, the following species of *Prosphingites* are known: *Prosphingites austini* Hyatt and Smith, *P. ovalis* Kiparisova, *P. orientalis* Kiparisova, *P. sinensis* Chao, *P. involutus* Chao, *P. kwangsianus* Chao, *P. radians* Chao, *P. spathi* Frebold, *P. slossi* Kummel and Steele. The documentation and illustration of all these species from essentially contemporaneous deposits in western United States, Arctic Canada, Spitsbergen, eastern Siberia, and southern China has added much to our understanding of *Prosphingites* during the mid-Scythian. When I introduced the species *P. slossi* (Kummel and Steele, 1962) I was fully cognizant of its close relationship and perhaps identity to *P. austini* Hyatt and Smith; however, on the argument that *P. austini* was known only from a single, not very well preserved specimen, I considered it best to ignore the species. However, subsequently, on study of all the new Scythian species that have been introduced, and thorough restudy of *P. austini*, I am convinced that *P. ovalis*, *P. orientalis*, *P. sinensis*, *P. radians*, *P. spathi*, and *P. slossi* are synonyms of *P. austini*. Large populations of these species are known only for *P. spathi* and *P. slossi*. Large numbers of specimens of *P. spathi* are in the British Museum (Natural History), but only a few measurements are available. Nearly all the Spitsbergen specimens are small phragmocones or juvenile specimens.

Kummel and Steele (1962: 683) have presented measurements on 49 specimens of *P. slossi* from the *Meekoceras* beds at Crittenden Spring, Nevada. A plot of the available measurements of the other species of *Prosphingites* shows them to fall within the limits of variations for *P. slossi*. The Nevada fauna likewise shows that the pattern of constrictions is highly variable. Evaluation of the suture in all these species is more difficult, as generally only one pattern is given for any species by most authors. However, on the basis of the variability in suture within the Crittenden Spring fauna and within *P. spathi* from the Canadian Arctic described by Tozer (1961d), I believe that the pattern for all the various species placed in the synonmy of *P. austini* is essentially the same, and what variation is present is partly due to the small size of the sample (generally one suture per species) and, more fundamentally, is no more than one should expect. The suture of these mid-Scythian species of the *Owenites* Zone is in general simpler than for species in higher Scythian zones. This is especially marked in the nature of the ventral lobe and in the auxiliary lobe (Fig. 16).

No species of *Prosphingites* are known from the *Columbites* Zone. The following species have been described from the upper Scythian *Subcolumbites-Olenekites* fauna: *Prosphingites czekanowskii* Mojsisovics, *P. globosus* Kiparisova, *P. insularis* Kiparisova, *P. lolouensis* Chao, *P. ali* Arthaber, *P. vonderschmitti* Renz and Renz, and *P. coombsi* Kummel.

Prosphingites czekanowskii is unique in its compressed living chamber and acute venter, but the suture is relatively simple (Fig. 16G, H) and not unlike that of species in the *Owenites* Zone. *Prosphingites globosus* is based on a few, very small, immature specimens and is too incompletely known to make meaningful comparisons; the same can be said for *P. ali*, but in each case the suture is of an advanced type with a more distinct auxiliary lobe and more elaborate ventral lobe (Fig. 16D–F). *Prosphingites lolouensis* is based on a few poorly preserved specimens. *Isculitoides globosus* Chao (1959: 292, pl. 26, figs. 9–13) appears to be a synonym of *P. lolouensis* Chao. *Prosphingites vonderschmitti* from the *Subcolumbites* fauna of Chios is a species of *Zenoites*.

Thus, there are now 16 described species of *Prosphingites*. Analysis of the nine species described from the mid-Scythian *Owenites* Zone leads me to accept only four of these as valid; the remaining five are synonyms. The valid species are: *P. austini*, known from western United States, Ellesmere Island, Spitsbergen, Primorye Region, and Kwangsi; *P. involutus* Chao, an incompletely known species from Kwangsi, China; *P. kwangsianus* Chao, another incompletely known species from Kwangsi; *P. magnumbilicatus* Kiparisova, presumably from the *Prosphingites* Zone (= *Owenites* Zone) of the Primorye Region. All of the species from the upper Scythian *Subcolumbites* Zone are believed to be valid except *P. vonderschmitti* Renz and Renz, which is a species of *Zenoites*.

The principal difference between most of these species of *Prosphinigites* of the upper Scythian and those of the mid-Scythian lies in the suture. The species from the upper Scythian tend to have sutures with phylloid saddles, more elaborate denticulation of the lobes, and a distinct auxiliary lobe.

Prosphingites czekanowskii Mojsisovics
Plate 26, figure 8; Text-figure 16

Prosphingites czekanowskii Mojsisovics, 1886: 64, pl. 15, figs. 10–12; Noetling, *in* Frech, 1905: 200, pl. 28, fig. 8; Diener, 1915: 233; Spath, 1934: 33, 195, 196; Kiparisova, 1937: 140, pl. 1, fig. 2; Kiparisova, 1947: 142, pl. 32, figs. 4, 5, text-fig. 28; Kummel, 1961: 522; Popov, 1961: 58, pl. 13, fig. 4.

Prosphingites cf. *P. czekanowskii*,—Tozer, 1965a: 19, pl. 2, figs. 5a–c, text-fig. 3.

This very characteristic and almost unique type species is known from relatively few specimens. In the two main discussions of the species by Mojsisovics (1886) and Popov (1961) it appears there were only a total of five specimens. One topotype specimen is now in the Museum of Comparative Zoology. The major features of the species are the globose, depressed inner whorls grading adorally to more compressed whorls, and a sharpening of the venter. The suture is shown on Figures 6G, H. I include within this species the specimen Tozer (1965a) records from British Columbia. Even though this specimen is partially crushed, the visible conch features and the suture indicate this identification.

This species is unique in that in no other species assigned to *Prosphingites* does the venter become acute. In the suture, also, this species differs from most other species of *Prosphingites* from the upper Scythian in the reduced character of the auxiliary lobe. In this aspect it is more comparable to the suture found in species of *Prosphingites* from the *Owenites* Zone. There is also no development of phylloid saddles such as characterize *P. globosus*, *P. insularis* and *P. coombsi*, all of late Scythian age.

Occurrence. *Olenekites* fauna, northern Siberia, and Toad Formation, Halfway River area, British Columbia.

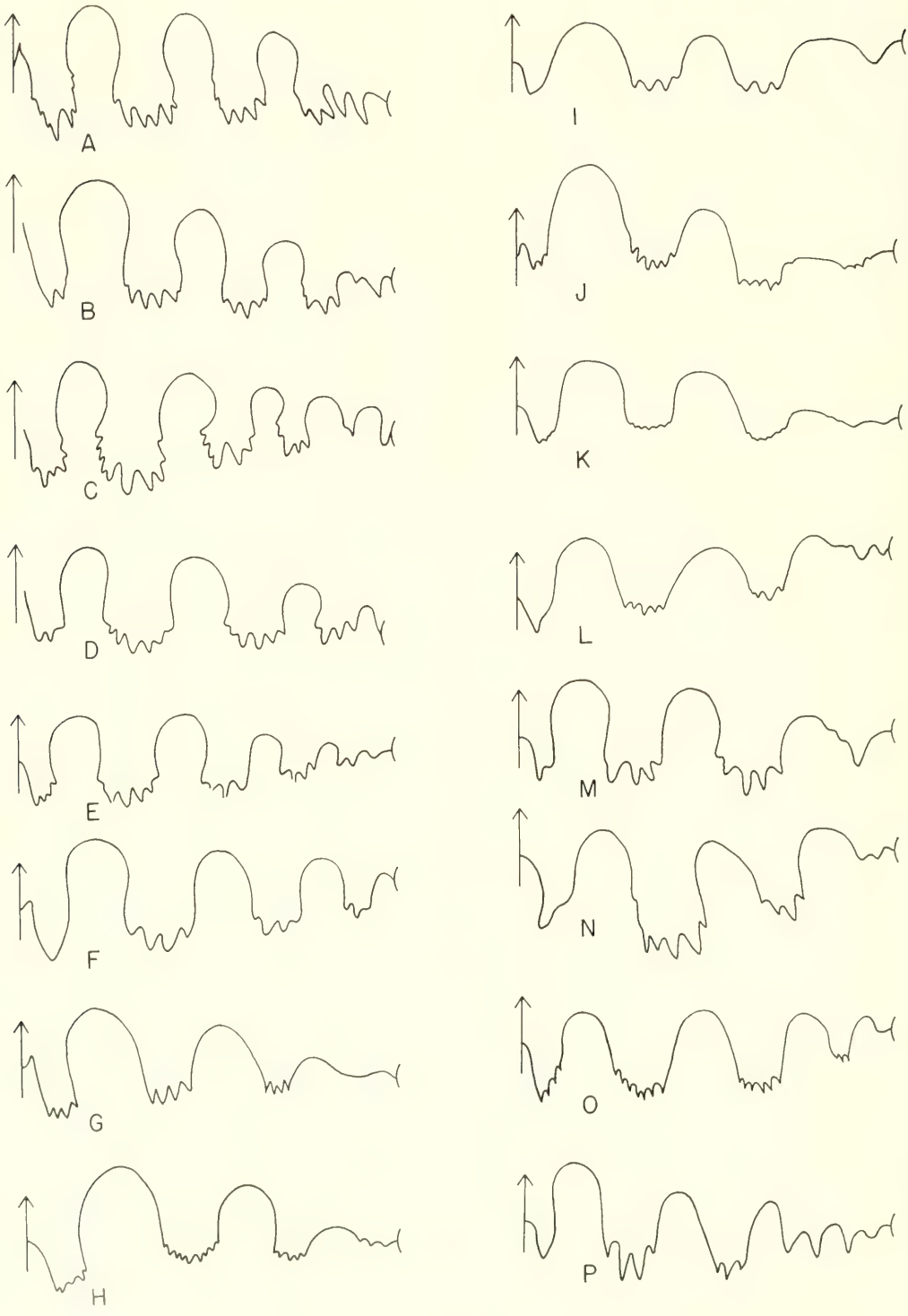
Repository. The Museum of Comparative Zoology has one topotype specimen (8677).

Prosphingites ali Arthaber
Plate 20, figures 12, 13; Text-figure 16

Prosphingites ali Arthaber, 1911: 252, pl. 22(6), figs. 6, 7; Diener, 1915: 233; Spath, 1934: 189, fig. 59g.

Arthaber (1911: 252) states he had three specimens of this species but only the specimen he illustrated is preserved. The dimensions of this specimen are as follows: Diameter 15.3, Width 10.2, Height 6.0, Umbilicus 4.7 mm. The specimen preserves much of the shell but this has been polished and is perfectly smooth. This specimen likewise does not show any trace of a suture; it is presumed that the suture Arthaber figured (1911, pl. 22(6), fig. 6c; Fig. 16F of this report) came from one of the other two specimens he had in his original collection.

This species was based on what are obviously juvenile forms, making comparisons with other species of the genus tenuous at best. It is of special interest that the closely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related *Subcolumbites* fauna of Chios does not contain any true *Prosphingites*. The specimen described by Renz and Renz (1948: 39, pl. 15, figs. 13, 15) as *Prosphingites vonderschmitti* is a species of *Zenoites*; the specimen they assigned to *Prosphingites* ex aff. *czekanowskii* is a representative of *Zenoites helenae* Renz and Renz.

Occurrence. *Subcolumbites* fauna, Kčira, Albania.

Repository. The holotype is in the Paleontological Institute, Vienna.

Prosphingites lolouensis Chao

Prosphingites lolouensis Chao, 1959: 123, 298, pl. 27, figs. 18–24, text-fig. 39b.
Isculitoides globosus Chao, 1959: 119, 292, pl. 26, figs. 9–13.

This is a most unsatisfactory species group. *Prosphingites lolouensis* was established for a "great number" of deformed specimens that never should have been given a new specific name. The specimens assigned by Chao (1959) to *Isculitoides globosus* have a prosphingitid suture, as noted by Chao (1959: 293), but he distinguished it on differences in the nature of the umbilical shoulders. Even considering the state of preservation of the Kwangsi material, I cannot separate these specimens from those assigned to *P. lolouensis*.

Occurrence. *Subcolumbites* fauna of Chashanao sections (Chao collection 610) and northeast of Lolou village (Chao collection 541a, b), Kwangsi, China.

Prosphingites subglobosus (Chao)

Paranannites subglobosus Chao, 1959: 113, 285, pl. 24, figs. 21–24, text-fig. 37a.

The most distinctive aspect of this species is the eccentricity of the umbilicus on the last volution. In this respect this species is quite different from all others assigned to *Prosphingites*. The suture is quite like that of the type species *P. czekanowskii* with a weakly developed auxiliary series.

Occurrence. *Subcolumbites* fauna, Naliling section (Chao collections 542a, b), Kwangsi, China.

Prosphingites globosus Kiparisova
Text-figure 16

Prosphingites globosus Kiparisova, 1947: 142, pl. 32, figs. 6, 7, text-fig. 29; Kiparisova and Krishtofovich, 1954: 21, pl. 12, figs. 2, 3; Kummel, 1961: 523; Kiparisova, 1961: 108, pl. 25, figs. 1, 2, text-figs. 69, 70.
Prosphingites aff. *globosus* Kiparisova, 1961: 109, pl. 25, fig. 3, text-fig. 71.

A species based on two specimens, one of which is a very small juvenile. Main features are a very depressed whorl section with an involute conch and showing the beginnings of eccentricity of the umbilicus. The suture (Fig. 16D, E) is characterized

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Figure 16. Diagrammatic representation of the sutures of several species of *Prosphingites*. Sutures A–G are of species from the upper Scythian *Subcolumbites* Zone, sutures I–P are of species from the mid-Scythian *Owenites* Zone. A, *P. coombsi* Kummel, paratype (OU3861), at a diameter of 21 mm, from near Kaka Point, New Zealand; B, *P. coombsi* Kummel, paratype (OU3863), at a diameter of 20 mm; C, *P. insularis* Kiparisova (1961: fig. 74), at a whorl height of 9 mm from *Subcolumbites* fauna, Primorye Region; D, *P. globosus* Kiparisova (1961: fig. 69), at a whorl height of 3 mm, from *Subcolumbites* fauna, Primorye Region; E, *P. globosus* Kiparisova (1961: fig. 70), holotype, at a whorl height of 7 mm, from *Subcolumbites* fauna, Primorye Region; F, *P. ali* Arthaber (1911: pl. 22, fig. 6c), from *Subcolumbites* beds Kčira, Albania; G, *P. czekanowskii* Mojsisovics (1886: pl. 15, fig. 11c), from *Olenekites* fauna, Olenek River, Siberia; H, *P. czekanowskii* Mojsisovics, topotype (MCZ 8677), at a diameter of 31 mm; I, *P. austini* Hyatt and Smith (1905: pl. 7, fig. 4), from *Meekoceras* fauna, Union Wash, Inyo Range, California (USNM 75256), at a diameter of 20 mm; J, *P. slossi* Kummel and Steele, paratype, at a diameter of 18 mm from *Meekoceras* fauna, Crittenden Spring, Nevada; K, *P. slossi* Kummel and Steele (1961: text-fig. 15a), at a diameter of 30 mm, from *Meekoceras* fauna, Crittenden Spring, Nevada; L, *P. spathi* Frebold,—Tozer (1961: pl. 13, fig. 1c), at a diameter of 16 mm, from *Meekoceras* fauna, Blind Fiord Formation, Ellesmere Island; M, *P. ovalis* Kiparisova (1961: fig. 79), at a whorl height of 5 mm, from *Prosphingites* Zone, Primorye Region; N, *P. involutus* Chao (1959: pl. 28, fig. 9), from *Owenites* Zone, Kwangsi, China; O. *P. kwangsianus* Chao (1959: text-fig. 39d), from *Owenites* fauna, Kwangsi, China.

by slightly phylloid saddles and a well developed auxiliary lobe.

It is inescapable that perhaps both of the specimens of this species are juvenile forms. Until more material becomes available an assessment of this species is most difficult. The whorl section is more depressed than in any other species of *Prosphingites* recorded to date, and it is this feature which can be looked upon as the most distinguishing for the species.

Occurrence. *Subcolumbites* fauna, Russian Island, Cape Zhitkov, Primorye Region, eastern Siberia.

Prosphingites insularis Kiparisova
Text-figure 16

Prosphingites insularis Kiparisova, 1961: 112, pl. 24, figs. 2–4, 6, text-figs. 74–76.
Prosphingites aff. *insularis* Kiparisova, 1961: 114, pl. 24, fig. 5, text-fig. 77.
Prosphingites magnumbilicatus Kiparisova, 1961: 114, pl. 25, fig. 4, text-fig. 78.

A more evolute prosphingitid with depressed rounded whorls and a broad deep umbilicus. Its most characteristic feature is the suture with well denticulated lobes and phylloid saddles (Fig. 16C). In its external conch features this species is nearly identical with *P. coombsi* Kummel (1965); it is only in the dorsal suture that differences can readily be seen. This species has adjacent to the dorsal lobe two lateral lobes whereas in *P. coombsi* there are four. It differs both in conch shape and suture from *P. czekanowskii.* It differs from *P. globosus* mainly in conch shape and involution.

Occurrence. *Subcolumbites* fauna, Primorye Region, Siberia.

Prosphingites coombsi Kummel
Text-figure 16

Prosphingites coombsi Kummel, 1965: 538, figs. 1–5.

This species, in its general conch architecture, is nearly identical to *P. insularis* Kiparisova. It differs mainly in a more elaborate dorsal suture (Fig. 16A, B).

Occurrence. This species was established for specimens encountered in an isolated pocket within disturbed beds between Kaka Point and Nugget Point, south Otago, New Zealand. On the basis of the general morphology of the species, I have (Kummel, 1965) interpreted this horizon as late Scythian in age comparable to the horizon of *Subcolumbites* of the Tethyan and circum-Pacific region.

Repository. Department of Geology, Otago University, New Zealand. Four paratypes are in the Museum of Comparative Zoology (MCZ 10113).

Genus *Vickohlerites* Kummel, 1968
Type species, *Prenkites sundaicus* Welter, 1922

Vickohlerites sundaicus (Welter)

Prenkites sundaicus Welter, 1922: 150, pl. 168(4), figs. 18–21; Kutassy, 1933: 621; C. Renz, 1945: 301; Renz and Renz, 1947: 60; Renz and Renz, 1948: 29, pl. 12, fig. 1; Chao, 1959: 306.
"*Prenkites*" *sundaicus*,—Spath, 1930: 77; Spath, 1934: 188, 209.
Vickohlerites sundaicus,—Kummel, 1968a: 9, pl. 1, figs. 10, 11.

Welter (1922) described this species on the basis of a single specimen from Noel Niti, Timor, and was quite positive as to the close relationship of his specimen to *Prenkites malsorensis* Arthaber from the *Subcolumbites* fauna of Albania. This close relationship is difficult to see. *Prenkites* is a more involute form, with depressed whorls which contract on the adoral quarter volution. The umbilical shoulders are subangular and bear fine nodes. The Timor specimen has a diameter of 40.7 mm, an adoral whorl width of 21.5 mm, a height of the adoral whorl of 13.2 mm and an umbilical diameter of 20.3 mm. The conch is evolute, the umbilicus comprising approximately 50 percent of the conch diameter. The whorls are depressed with the maximum width at the umbilical shoulder. The venter is arched and grades with no perceptible ventral shoulders to the umbilical shoulder which is acutely rounded. The umbilical wall is steep but not vertical.

The last half volution of the specimens is body chamber and shows traces of delicate growth lines. The penultimate half volution bears a series of weak, forward projecting ridges which are most prominent on the center part of the venter and disappear completely midway between the venter and the umbilical shoulder.

It is in Welter's (1922, pl. 14, fig. 21) representation of the suture that one can pinpoint the uncertainty in interpretation of this form. Welter's drawing of the suture covers only the portion from the venter to the umbilical shoulder, but the drawing implies that it was a complete suture. A new drawing of the suture is given in Kummel (1968, fig. 1J). There are two prominent lateral lobes but the umbilical wall bears a good portion of a fairly large auxiliary saddle and a small but very distinct denticulated lateral lobe. The first author after Welter to comment on *Prenkites sundaicus* was Spath (1930, p. 77) who wrote, "'*Prenkites*' *sundaicus* Welter, in whorl shape resembles *Columbites*, but in suture line it is closer to *Subcolumbites*. . . ." In terms of Welter's representation of the suture this statement is correct. In *Columbites* the second lateral lobe is generally very small, consisting of a single prong, whereas in *Subcolumbites* the second lateral lobe, though much smaller than the first, is more highly developed in terms of its breadth and pattern of denticulation. On the basis of suture alone, *Prenkites sundaicus* can not be attached to either *Columbites* or *Subcolumbites*.

There is a general similarity in conch shape of *Prenkites sundaicus* with some groups of *Subcolumbites*. Among the subcolumbitids three distinct groups can be recognized. There is first of all the *perrinismithi* group with a tendency for carination of the venter; secondly the *dusmani* group with a more marked development of the reticulate ornamentation, a compressed whorl section, but lacking the tendency toward carination; finally there is the *robustus-multiformis* group characterized mainly by their depressed whorl section. It is to this last group that *Vickohlerites sundaicus* has great resemblance in conch form. Within the two subfamilies of the Paranannitidae those genera assigned to the Columbitinae tend to have sutures lacking an auxiliary lobe, whereas within the Paranannitinae an auxiliary lobe is commonplace, as in *Prosphingites, Zenoites, Chiotites*, etc. It is within this subfamily that *Vickohlerites sundaicus* belongs.

Renz and Renz (1948: 24, pl. 12, fig. 1) have described and illustrated a single specimen from the *Subcolumbites* fauna of Chios as a representative of this species. The general conch form of their specimen is the same as that of the type specimens from Timor. This Chios specimen measures 55.5 mm in diameter, 21.4 mm for the width of the adoral whorl, 19 mm for the height, and 23.5 mm for the width of the umbilicus. The dimensions of the whorl height and umbilical diameter in the two specimens are reasonably similar. However, the Timor specimen has a broader whorl than the Chios specimen by approximately 14 percent. This difference in whorl width is difficult to evaluate, as each locality has yielded only a single specimen. In addition, the Chios specimen, apparently, does not show the suture. The overall similarity of the Chios specimen to that from Timor is such that, in spite of the differences and lack of data mentioned above, the two specimens should be considered as conspecific.

The new specimen recorded by Kummel (1968) as *Vickohlerites* cf. *sundaicus* from a *Subcolumbites* fauna at Kotal-e-Tera, Afghanistan, is clearly congeneric with the Timor and Chios specimens discussed above but is not conspecific. Critical comparison of the Afghan and Timor forms is difficult, as each is represented by a single specimen. There is an overall similarity between the two specimens, but at the same time there are intriguing differences in whorl shape and suture.

Occurrence. The holotype is from Noel

Niti, Timor. Welter (1922: 85, 86) considered this specimen to come from his lowest Triassic horizon. The forms associated with this specimen he lists on page 150 as *Meekoceras* sp. indet. The available evidence does not allow any precise determination of the age, but the biological affinities of this species suggest that it is late Scythian in age. The specimen recorded by Renz and Renz (1948) is from the *Subcolumbites* fauna of Chios.

Repository. The holotype is in the Paleontological Institute of Bonn University; the specimen from Chios is in the Natural History Museum, Basel J13576.

Genus *Zenoites* Renz and Renz, 1947
Type species, *Prosphingites (Zenoites) helenae* Renz and Renz, 1947

Generally small, somewhat evolute form with rounded, depressed whorl sections bearing irregularly spaced radial to prosiradiate constrictions that encircle the whorl section; suture consists of two denticulated lateral lobes, one auxiliary lobe on the umbilical shoulder and the appearance of another lobe on the umbilical seam.

The suture and general shape of the conch indicate a relationship to *Prosphingites.* This genus was first recognized from the *Subcolumbites* fauna of Chios by Renz and Renz (1948). Since then it has been recognized from a late Scythian horizon on Ellesmere Island (Tozer, 1965a).

Zenoites helenae Renz and Renz
Text-figure 17

Prosphingites (Zenoites) helenae Renz and Renz, 1947: 60, 75; Renz and Renz, 1948: 41, pl. 15, figs. 8–8a, pl. 16, figs. 1–1c.

Prosphingites (Zenoites) helenae var. *maradovunensis* Renz and Renz, 1947: 60, 75; Renz and Renz, 1948: 42, pl. 15, figs. 12–12a, 14–14a.

Zenoites helenae,—Kummel, *in* Arkell et al., 1957: L139, figs. 172, 4.

Prosphingites ex aff. *czekanowskii*,—Renz and Renz, 1948: 39, pl. 15, figs. 11–11b.

The variety established for this species (*maradovunensis*) consists merely of two slightly more compressed forms. The measurements of the figured specimens are as follows:

	D	W	H	U	W/D	H/D	U/D
1.	24.0	13.4	8.7	9.4	55.8	36.3	39.2
2.	17.4	?	5.3	6.5	?	30.5	37.4
3.	21.6	10.2	7.2	9.3	47.2	33.3	43.1
4.	17.7	9.0	6.4	6.1	50.8	36.2	34.5

1. Holotype, NHMB J13648, Renz and Renz, 1948: pl. 16, fig. 1.
2. Paratype, NHMB J13649, Renz and Renz, 1948: pl. 15, fig. 8.
3. var. *maradovunensis*, NHMB J13652, Renz and Renz, 1948: pl. 15, fig. 14.
4. var. *maradovunensis*, NHMB J13651, Renz and Renz, 1948: pl. 15, fig. 12.

This species is not common in the Chios fauna; Renz and Renz record only five specimens, and there are 9 additional specimens in the Natural History Museum, Basel. The suture is shown on Figure 17A.

Occurrence. Subcolumbites fauna, Maradovuno, Chios.

Repository. Holotype, NHMB J13648; figured paratypes NHMB J13649, J13651, J13652; unfigured paratypes NHMB J13650.

Zenoites vonderschmitti (Renz and Renz)
Text-figure 17

Prosphingites vonderschmitti Renz and Renz, 1947: 60, 74; Renz and Renz, 1948: 39, pl. 15, figs. 13, 15.

This is a highly compressed form in comparison to the genotype *helenae.* The holotype (Renz and Renz, 1948: pl. 15, fig. 13) measures 24.6 mm in diameter, 9.5 mm for the width of the adoral whorl, 7.3 for the height, and 10.8 mm for the diameter of the umbilicus. The paratype (Renz and Renz, 1948: pl. 15, fig. 15) measures 15.7 mm in diameter, 5.2 mm for the height of the adoral whorl and 7.1 mm for the diameter of the umbilicus (faulty preservation prevents obtaining a whorl width measurement). Aside from the very different whorl dimensions, this species has a different pattern of constriction. The suture, however, (Fig. 17B) is almost identical in these two Chios species.

Occurrence. Subcolumbites fauna, Chios.

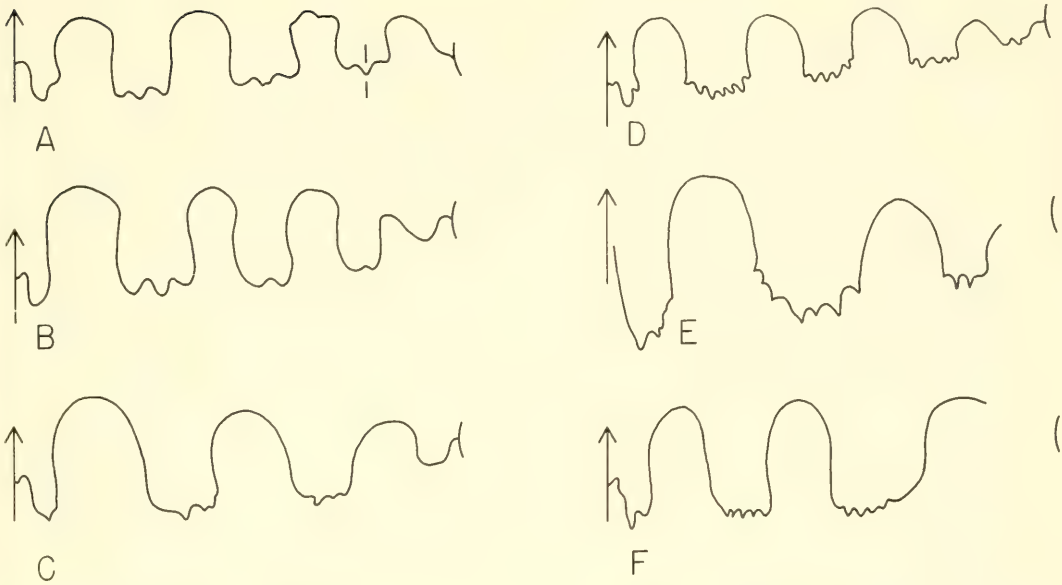


Figure 17. Diagrammatic representation of the suture of: A, holotype *Zenoites helenae* Renz and Renz (1948: pl. 16, fig. 1c), at a diameter of approximately 18 mm; B, holotype of *Prosphingites vonderschmitti* Renz and Renz (1948: pl. 15, fig. 13c), at a diameter of approximately 18 mm; C, paratype *Columbites huangi* Chao (1959: pl. 29, fig. 11), at a diameter of approximately 20 mm; D, paratype *Chiotites globularis* Renz and Renz (1948: pl. 15, fig. 9c), at a diameter of approximately 15 mm; E, paratype *Popovites occidentalis* Tozer (1965: fig. 5b), at a diameter of approximately 30 mm; F, paratype *Monacanthites monoceras* Tozer (1965: fig. 8), at a diameter of approximately 15 mm.

Specimens of figures A, B, C from *Subcolumbites* fauna of Chios; D, E from Toad Formation, British Columbia; F, from upper Scythian of Ellesmere Island.

Repository. Holotype NHMB J13639 (Renz and Renz, 1948: pl. 15, fig. 13); paratype NHMB J13640 (Renz and Renz, 1948: pl. 15, fig. 15); unfigured paratypes NHMB J13641.

Zenoites arcticus Tozer

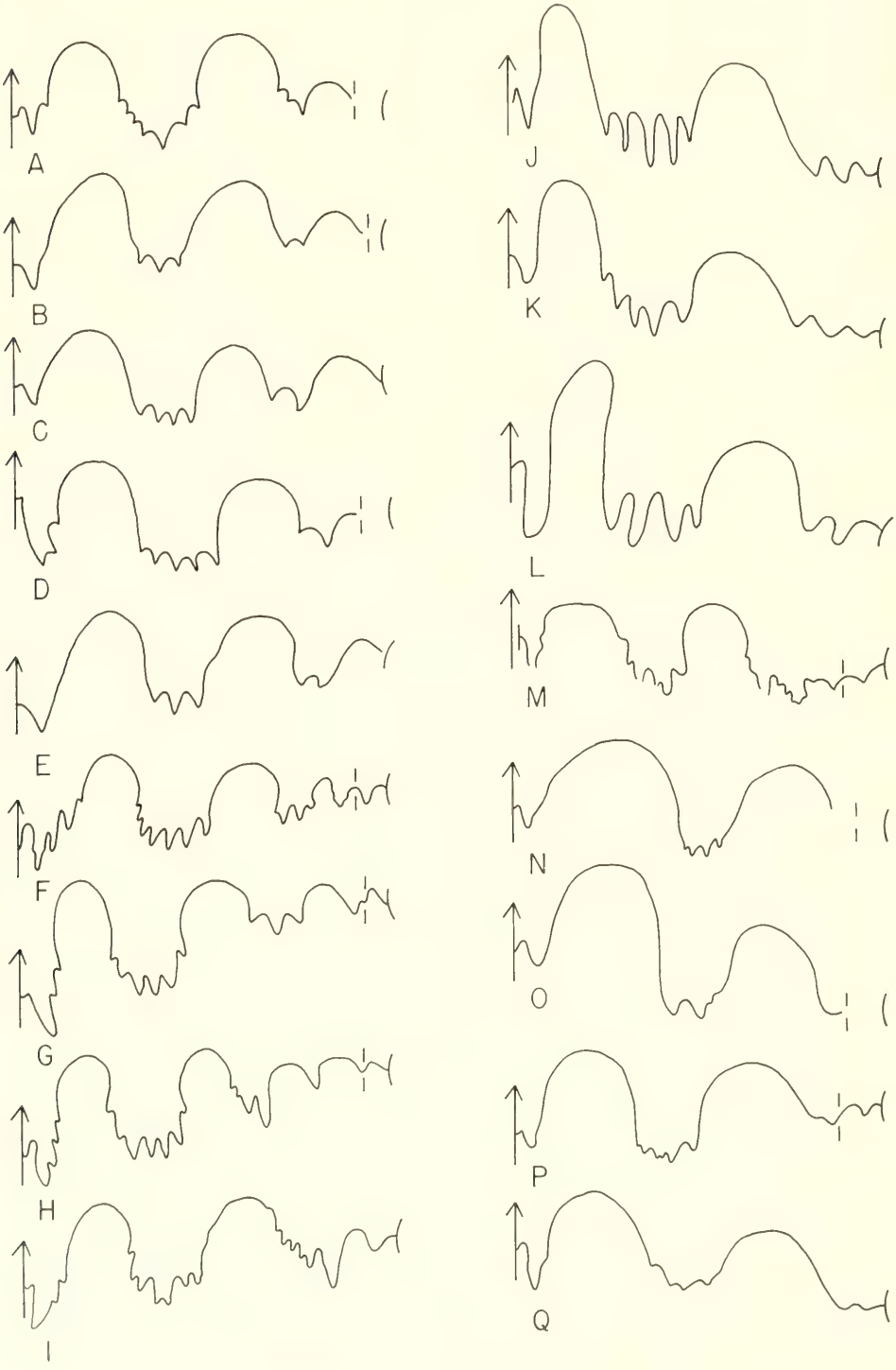
Zenoites arcticus Tozer, 1965a: 25, pl. 2, figs. 6, 7, text-fig. 7.

Only two specimens of this species are known. It differs from Z. *helenae* mainly in the pattern of constriction.

Occurrence. Blaa Mountain Formation, lower shale member, Ellesmere Island.

Genus *Isculitoides* Spath, 1930
Type species, *Isculites originis* Arthaber, 1911

This is another of the genera which are confined to the late Scythian *Prohungarites* Zone, where it is represented by six species. In the *Subcolumbites* fauna of Albania and Chios, *I. originis* is one of the most common species. This species in the Chios fauna shows a very large degree of intraspecific variation. *Isculitoides ellipticus* from Kwangsi, China, *I. minor* from British Columbia, and *I. suboviformis* from the Primorye Region are represented by very few specimens. Additional collections of these three species are badly needed to clarify their relationships. In the western United States we have *I. wasserbergi* and *I. hammondi*, both species known from a fair number of specimens. Specimens assigned to *Isculitoides* cf. *originis* have been recorded from the *Subcolumbites* fauna at Kotal-e-Tera, Afghanistan (Kummel, 1968b) and specimens of indeterminant specific identity from the *Prohungarites* fauna of the Salt Range, West Pakistan.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Isculitoides originis (Arthaber)
Plate 5, figures 1–10; Plate 6, figures 1–6; Text-figures 18–20

Isculites originis Arthaber, 1911: 259, pl. 23(7), figs. 1–10; Diener, 1915: 157; C. Renz, 1928: 155; Kutassy, 1933: 540; Renz and Renz, 1947: 60; Renz and Renz, 1948: 33, pl. 13, figs. 7–7a, 9–9a, 11–11b, 12–12b, pl. 14, figs. 6–6a, 9–9a.

Isculitoides originis,—Spath, 1934: 198, pl. 14, figs. 2a–d, text-fig. 59b, c.

Iscultites globulus Renz and Renz, 1947: 60, 74; Renz and Renz, 1948: 34, pl. 14, figs. 10–10c, 4–4a, 5–5a, 8–8b, 11–11b.

Iscultites antiglobulus Renz and Renz, 1947: 60, 74; Renz and Renz, 1948: 35, pl. 13, figs. 1–1a, 10–10a, pl. 13, figs. 2–2a, 3–3a, 5–5a, 8–8a.

Iscultites globulus-originis Renz and Renz, 1947: 60; Renz and Renz, 1948: 35, pl. 13, figs. 6–6a, pl. 14, figs. 1–1a, 2–2a, 3–3a.

Iscultites globulus-antiglobulus Renz and Renz, 1947: 60; Renz and Renz, 1948: 35, pl. 13, figs. 4–4a, pl. 14, figs. 7–7a.

Arthaber (1911: 259) stated he had 54 specimens of this species, 10 of which he illustrated. The type specimen and seven paratypes, all among those illustrated by Arthaber (1911), are still preserved. The preservation of all these specimens leaves much to be desired and most are too badly preserved or incomplete to yield significant measurements. Arthaber's (1911: pl. 23(7), figs. 1–10) illustrations are highly retouched and idealized; unretouched photographs of the existing original specimens are reproduced here on Plates 5 and 6.

One of the most common elements in the *Subcolumbites* fauna of Chios is this species. Renz and Renz (1948) had available for study several hundred specimens. Of this vast number of specimens 126 are sufficiently complete and well preserved to yield measurements of the basic conch dimensions. These data are tabulated on Table 31, and plotted on Figures 19 and 20. Renz and Renz (1948) recognized five species of this genus within the Chios fauna. These are: *originis*, *globulus*, *antiglobulus*, *globulus-originis*, and *globulus-antiglobulus*. The latter two species were named for intermediate forms between the first three species. These "Formenreihen" are distinguished basically on conch thickness and size of the umbilicus. *Isculitoides globulus*, considered by Renz and Renz as the point of origin of their "Formenreihen," is a globular form with a relatively small umbilicus. They recognized one series of transitional forms to *Isculitoides antiglobulus*, which has a more compressed conch and a more open umbilicus. Another series extended from *Isculitoides globulus* to *I. originis*, which is a compressed form with no appreciable difference in the diameter of the umbilicus. A plot of the whorl width (Fig. 19) and the umbilical diameter (Fig. 20) of these species recognized by Renz and Renz demonstrates the

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Figure 18. Diagrammatic representation of the sutures of various species of *Isculitoides*. A–I, *Isculitoides originis* (Arthaber), A–E from *Subcolumbites* fauna, Albania, F–I from *Subcolumbites* fauna, Chios. A, holotype (Arthaber, 1911: pl. 23(7), fig. 1c), no sutures are visible on the type specimen; B, paratype (Arthaber, 1911: pl. 23(7), fig. 9), redrawn from type specimen; C, paratype (Arthaber, 1911: pl. 23(7), fig. 6c), no sutures are visible on the type specimen; D, paratype (Arthaber, 1911: pl. 23(7), fig. 8), specimen apparently lost; E, paratype (Arthaber, 1911: pl. 23(7), fig. 9), specimen apparently lost; F, plesiotype (Renz and Renz, 1948: pl. 13, fig. 12b, NHMB J-13590), at a diameter of approximately 35 mm; G, plesiotype (Renz and Renz, 1948: pl. 13, fig. 11b, NHMB J-13591), at a diameter of approximately 35 mm; H, paratype *Iscultites globulus* Renz and Renz (1948: pl. 14, fig. 8b, NHMB J-13602), at a diameter of approximately 25 mm; I, paratype *Iscultites globulus* Renz and Renz (1948: pl. 14, fig. 11b, NHMB J-13600), at a diameter of approximately 25 mm; J–L, *I. ellipticus* Chao (1959), from *Subcolumbites* fauna, Kwangsi, China; J, holotype (Chao, 1959: fig. 38a), at a whorl height of 7 mm; K, paratype (Chao, 1959: fig. 38b), at a whorl height of 5 mm; L, paratype (Chao, 1959: pl. 30, fig. 3), at a diameter of approximately 25 mm; M, *I. suboviformis* (Kiparisova, 1961: fig. 97), from *Subcolumbites* fauna, Primorye Region, at a diameter of approximately 15 mm; N–P, *I. wasserbergi* n. sp. from *Subcolumbites* fauna, Tobin Formation, Nevada, N, paratype, at a diameter of 8.5 mm (MCZ 9626); O, paratype, at a diameter of 8 mm (MCZ 9450, Pl. 29, figs. 9, 10); P, paratype, at a diameter of 8 mm (MCZ 9657); Q, paratype *I. hammondi* n. sp., from Upper Thaynes Formation, Hammond Creek, southeast Idaho, at a diameter of 13 mm (MCZ 9480).

Figure 19. Variation in whorl width (W) of *Isculitoides originis* (Arthaber), from the *Subcolumbites* fauna of Chios. The data on this graph are from Table 31.

completely transitional nature of these two characters.

Renz and Renz (1948: 33) recognized that the basic plan of the suture was the same in the Chios and Albanian populations (Fig. 18 A–I). What variations do occur are minor changes in the shape of the elements and in the denticulation of the lobes.

Among late Scythian ammonite faunas, species of *Isculitoides* are recognized from Timor, Kwangsi, Primorye Region, British Columbia, Nevada, and southeastern Idaho. The Timor forms belong in *I. originis* (Spath, 1934: 198). None of the remaining species are known by more than a few specimens, which makes comparison to *I. originis* difficult. *Isculitoides subovi-formis* Kiparisova from the Primorye Region and *I. wasserbergi* n. sp. from Nevada are extremely depressed forms; *I. ellipticus* Chao from Kwangsi and *I. hammondi* n. sp. are similar in conch shape to *I. orginis* but are much more involute, not showing as strong an excentrumbilication of the umbilicus.

Occurrence. *Subcolumbites* fauna of Albania and Chios, and from the man-

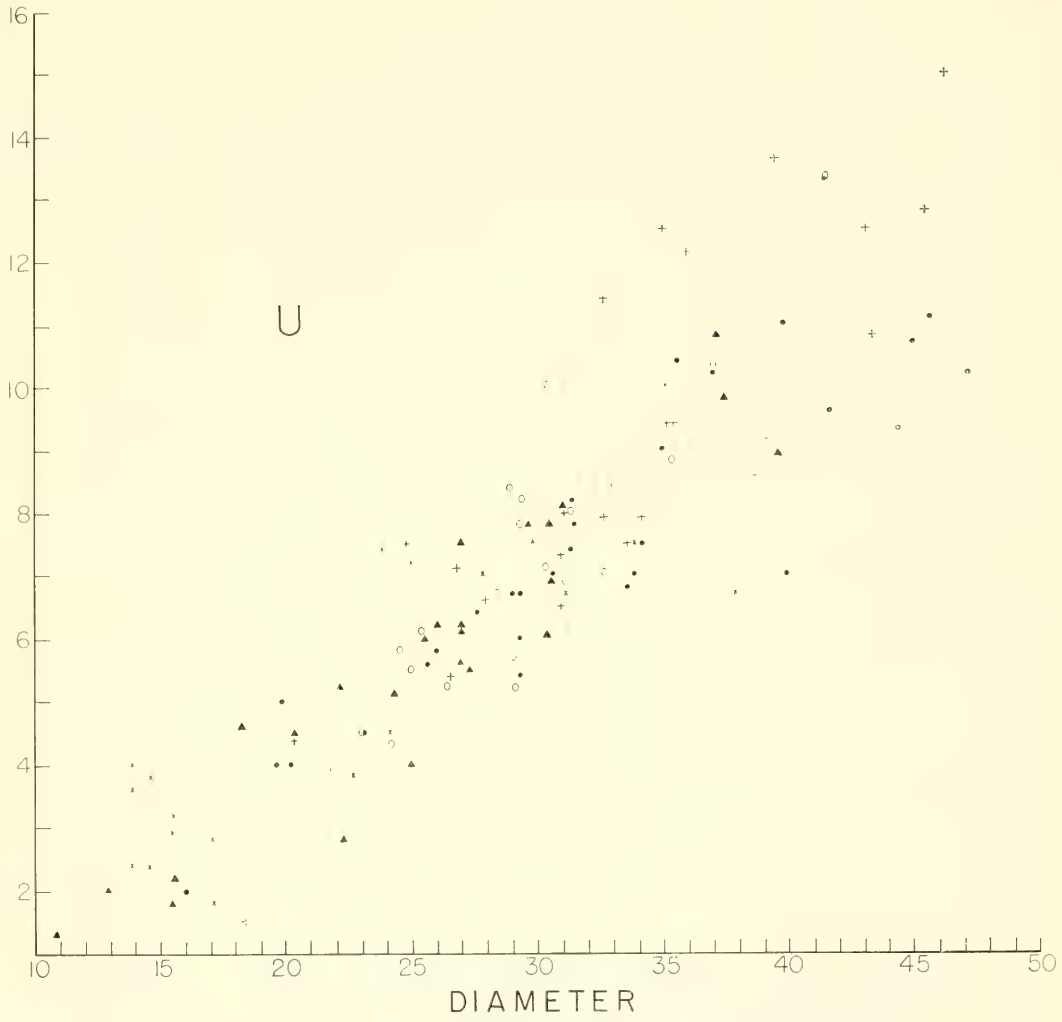


Figure 20. Variation in umbilical diameter (U) of *Isculitoides originis* (Arthaber), from *Subcolumbites* fauna of Chios. The data on this graph are from Table 31.

ganese coated fauna with *Prohungarites* of Nifoekoko and Toeboelopo, Timor.

Repository. The genotype and 7 paratypes are preserved in the Paleontological Institute, University of Vienna. These are the specimens of Arthaber's plate 23(7), figs. 1–7, 10.

The specimens of this species from Chios described by Renz and Renz (1948) are in the Natural History Museum, Basel; these are as follows: plesiotypes, *I. originis* (pl. 13, fig. 7) NHMB J13584, (pl. 13, fig. 9) NHMB J13585, (pl. 13, fig. 11a) NHMB J13586, (pl. 13, fig. 11b) NHMB J13591, (pl. 13, fig. 12a) NHMB J13587, (pl. 13, fig. 12b) NHMB J13590, (pl. 14, fig. 6) NHMB J13588, (pl. 14, fig. 9) NHMB J13589; unfigured specimens of *I. originis* from Maradovuno NHMB J13592, J13593, J13594, from Kephalovuno NHMB J13595; holotype, *I. globulus* (pl. 14, fig. 10a, b) J13596, (pl. 14, fig. 10c) J13601; paratypes,

TABLE 31. MEASUREMENTS OF *ISCULITOIDES ORIGINIS* (ARTHABER) FROM THE *SUBCOLUMBITES* FAUNA OF CHIOS.

The species names on this list are those recognized by Renz and Renz (1948). The measurements are distinguished on Figure 19 and Figure 20.

	D	W	H	U	W/D	H/D	U/D
1.	47.2	15.5	20.0	10.2	32.8	42.4	21.6
2.	45.7	16.1	17.8	11.1	35.2	38.9	24.3
3.	45.0	14.6	19.2	10.7	32.4	42.7	23.8
4.	44.4	?	19.6	9.3	?	44.1	20.9
5.	41.7	13.8	16.3	9.6	33.1	39.1	23.0
6.	39.8	14.6	18.1	7.0	36.7	45.5	17.6
7.	39.8	14.3	15.2	11.0	35.9	38.2	27.6
8.	37.0	?	14.0	10.2	?	37.8	27.6
9.	35.6	12.7	13.9	10.4	35.7	39.0	29.2
10.	35.0	11.7	13.5	9.0	33.4	38.6	25.7
11.	34.2	11.5	14.8	7.5	33.6	43.3	21.9
12.	33.8	12.5	14.2	7.0	37.0	42.0	20.7
13.	33.6	12.1	14.2	6.8	36.0	42.3	20.2
14.	31.5	11.2	12.8	7.8	35.6	40.6	24.8
15.	31.4	12.1	13.2	8.2	38.5	42.0	26.1
16.	31.3	11.8	12.3	7.4	37.7	39.3	23.6
17.	30.7	11.7	12.1	7.0	38.1	39.4	22.8
18.	29.3	11.2	12.0	6.7	38.2	41.0	22.9
19.	29.3	10.2	12.0	6.0	34.8	41.0	20.5
20.	29.3	10.6	13.2	5.4	36.2	45.1	18.4
21.	29.0	10.7	11.1	6.7	36.9	38.3	23.1
22.	29.0	11.8	12.3	6.7	40.7	42.4	23.1
23.	27.6	10.5	11.5	6.4	38.0	41.7	23.2
24.	26.0	10.3	11.0	5.8	39.6	42.3	22.3
25.	25.7	9.8	10.1	5.6	38.1	39.3	21.8
26.	23.1	9.8	9.0	4.5	42.4	40.0	19.5
27.	20.2	7.9	8.3	4.0	39.1	41.1	19.8
28.	19.8	8.0	8.2	5.0	40.4	41.4	25.3
29.	19.7	7.3	8.7	4.0	37.1	44.2	20.3
30.	16.0	6.6	7.0	2.0	41.3	43.8	12.5
			Isculitoides globulus				
31.	37.8	15.0±	17.3	6.7	39.7±	45.8	17.7
32.	35.2	17.8	12.6	10.0	50.6	35.8	28.4
33.	33.8	16.5±	14.8	7.5	48.8±	43.8	22.2
34.	31.2	19.8	13.0	6.7	63.5	41.7	21.5
35.	29.9	19.8	13.3	7.5	66.2	44.5	25.1
36.	27.8	16.6	11.5	7.0	59.7	41.4	25.2
37.	25.0	15.2	9.3	7.2	60.8	37.2	28.8
38.	24.2	13.8?	11.6	4.5	57.0?	47.9	18.6
39.	23.8	15.0	10.5	7.4	63.0	44.1	31.1
40.	22.7	16.7	11.5	3.8	73.6	50.7	16.7
41.	17.1	11.7	8.0	1.8	68.4	46.8	10.5
42.	17.0	11.1	7.4	2.8	65.3	43.5	65.0
43.	15.5	10.7	7.2	3.2	69.0	46.5	20.6
44.	15.4	9.3	8.8	2.9	60.4	57.1	18.8
45.	14.6	9.7	6.4	3.8	66.4	43.8	26.0
46.	14.5	9.8	6.6	2.4?	67.6	45.5	16.6?
47.	13.8	10.0	5.6	3.6	72.5	40.6	26.1
48.	13.8	8.3	6.2	2.4	60.1	44.9	17.4
49.	13.8	9.8	5.0	4.0	71.0	36.2	29.0
			Isculitoides antiglobulus				
50.	46.3	13.7	16.4	15.0	29.6	35.4	32.4
51.	45.5	12.6	16.8	12.8	27.7	36.9	28.1
52.	43.3	11.9	16.6	10.8	27.5	38.3	24.9
53.	43.2	14.3	16.1	12.5	33.1	37.3	28.9
54.	39.5	?	14.0	13.6	?	35.4	34.4
55.	36.0	12.2	11.9	12.1	33.9	33.1	33.6
56.	35.3	11.4	13.7	9.4	32.3	38.8	26.6
57.	35.2	12.1	14.7	9.4	34.4	41.8	26.7
58.	35.0	13.2	12.5	12.5	37.7	35.7	35.7
59.	34.1	11.0	13.4	7.9	32.3	39.3	23.2
60.	33.6	12.3	13.8	7.4	36.6	41.1	22.0
61.	32.7	10.3	13.3	7.9	31.5	40.7	24.2
62.	32.7	11.1?	11.4	11.4	33.9?	34.9	32.9
63.	31.1	10.0	12.2	8.0	32.2	39.2	25.7
64.	31.0	10.7	12.2	6.5	34.5	39.4	31.0

1. Plesiotype, Renz and Renz (1948: pl. 13, fig. 12), NHMB J13587.
2. Plesiotype, Renz and Renz (1948: pl. 13, fig. 11), NHMB J13586.
4. Plesiotype, Renz and Renz (1948: pl. 13, fig. 11b), NHMB J13591.
5. Plesiotype, Renz and Renz (1948: pl. 13, fig. 9), NHMB J13585.
6. Plesiotype, Renz and Renz (1948: pl. 13, fig. 12b), NHMB J13587.
11. Plesiotype, Renz and Renz (1948: pl. 13, fig. 7), NHMB J13584.
13. Plesiotype, Renz and Renz (1948: pl. 14, fig. 9), NHMB J13589.
26. Plesiotype, Renz and Renz (1948: pl. 14, fig. 6), NHMB J13588.

Remaining specimens from 3–30, unfigured paratypes from Maradovuno, Chios, NHMB J13592, 13593, 13594.

31. Paratype, Renz and Renz (1948: pl. 14, fig. 8b), NHMB J13602.
32. Paratype, Renz and Renz (1948: pl. 14, fig. 11), NHMB J13600.
33. Paratype, Renz and Renz (1948: pl. 14, fig. 8), NHMB J13599.
35. Holotype, Renz and Renz (1948: pl. 14, fig. 10), NHMB J13596.
37. Paratype, Renz and Renz (1948: pl. 14, fig. 4), NHMB J13597.
38. Paratype, Renz and Renz (1948: pl. 14, fig. 5), NHMB J13598.
40. Paratype, Renz and Renz (1948: pl. 14, fig. 10c), NHMB J13596.

Remaining specimens from 34–49, unfigured paratypes from Maradovuno, Chios, NHMB J13603.

50. Paratype, Renz and Renz (1948: pl. 13, fig. 1), NHMB J13606.
53. Paratype, Renz and Renz (1948: pl. 13, fig. 2), NHMB J13607.
54. Paratype, Renz and Renz (1948: pl. 13, fig. 3), NHMB J13608.
56. Paratype, Renz and Renz (1948: pl. 13, fig. 8), NHMB J13610.
58. Paratype, Renz and Renz (1948: pl. 13, fig. 5), NHMB J13609.
62. Holotype, Renz and Renz (1948: pl. 13, fig. 10), NHMB J13605.

Remaining specimens from 51–72, unfigured paratypes from Maradovuno, Chios, NHMB J13617.

TABLE 31. *Continued*

	D	W	H	U	W/D	H/D	U/D
65.	31.0	10.3	12.2	7.3	33.2	39.4	23.5
66.	28.0	9.6	11.0	6.6	34.3	39.3	23.6
67.	28.0	9.7	11.2	6.6	34.6	40.0	23.6
68.	26.8	9.3	11.0	7.1	34.7	41.0	26.5
69.	26.6	9.4	12.2	5.4	35.3	45.9	20.3
70.	24.8	9.1	9.1	7.5	36.7	36.7	30.2
71.	20.4	7.8	8.3	4.4	38.2	40.7	21.6
72.	18.4	7.3	9.3	1.5?	39.7	50.5	8.2?
			Isculitoides globulusoriginis				
73.	39.6	17.9	16.8	8.9	45.2	42.4	22.5
74.	37.5	13.6	14.3	9.8	36.3	38.1	26.1
75.	37.2	13.7	13.1	10.8	36.8	35.2	29.0
76.	31.2	13.3?	13.2	8.1	42.6?	42.3	26.0
77.	30.7	14.0	13.7	6.9	45.6	44.6	22.5
78.	30.5	14.1	11.7	7.8	46.2	38.4	25.6
79.	30.4	13.8	12.5	6.1	45.4	41.1	20.1
80.	29.7	12.1	11.4	7.8	40.7	38.4	26.3
81.	27.4	11.0?	12.4	5.5	40.1?	45.3	20.1
82.	27.0	13.3	11.2	7.5	49.3	41.5	27.8
83.	27.0	12.0	11.1	6.2	44.4	41.1	23.0
84.	27.0	15.5	11.2	5.6	57.4	41.5	20.7
85.	27.0	14.2	11.2	6.1	52.6	41.5	22.6
86.	26.2	13.8	11.2	6.2	52.7	42.7	23.7
87.	25.6	12.6	10.1	6.0	49.2	39.5	23.4
88.	25.0	13.0?	11.6	4.0	52.0?	46.4	16.0
89.	24.3	13.0	10.4	5.1	53.5	42.8	21.0
90.	22.3	?	11.0	2.8	?	49.3	12.6
91.	22.2	11.7	10.0	5.2	52.7	45.0	23.4
92.	20.4	12.3	9.2	4.5	60.3	45.1	22.1
93.	18.3	10.9	7.2	4.6	59.6	39.3	25.1
94.	15.6	7.3	7.6	2.2	46.8	48.7	14.1
95.	15.5	7.7	7.6	1.8	49.7	49.0	11.6
96.	12.9	6.8	6.8	2.0?	52.7	52.7	15.5?
97.	10.8	6.7	5.5?	1.3?			
			Isculitoides globulusantiglobulus				
98.	41.5	16.3	15.3	13.3	39.3	36.9	32.0
99.	39.1	13.9	16.0	9.1	35.5	40.9	23.3
100.	39.0	12.9	15.7	9.2	33.1	40.3	23.6
101.	38.6	15.0	15.3	8.5	38.9	39.6	22.0
102.	37.0	15.2	14.6	10.3	41.1	39.5	27.8
103.	35.5	13.1	14.5	9.0	36.9	40.8	25.4
104.	35.3	12.7	13.5	8.8	36.0	38.2	24.9
105.	32.8	12.3	13.3	8.4	37.5	40.5	25.3
106.	32.7	13.2	14.0	7.0	40.4	42.8	21.4
107.	31.7	11.5	12.6	8.5	36.3	39.7	26.8
108.	31.3	12.3	12.7	8.0	39.3	40.6	25.6
109.	31.2	11.8	13.7	6.2	37.8	43.9	19.9
110.	31.1	12.8	12.3	6.9	41.2	39.5	22.2
111.	30.3	12.3	12.3	7.1	40.6	40.6	23.4
112.	30.3	14.2	11.7	10.0	46.9	38.6	33.0
113.	29.3	14.3	11.5	7.8	48.8	39.2	26.6
114.	29.3	11.5	11.1	8.2	39.2	37.9	28.0
115.	29.2	10.8	13.0	5.2	37.0	44.5	17.8
116.	29.0	13.0	12.4	5.7	44.8	42.8	19.7
117.	28.8	12.7	9.8	8.4	44.1	34.0	29.2
118.	28.4	10.2	10.9	6.7	35.9	38.4	23.6
119.	26.4	11.7	11.6	5.2	44.3	43.9	19.7
120.	25.4	11.9	11.0	6.1	46.9	43.3	24.0
121.	25.0	12.2	11.4	5.5	48.8	45.6	22.0
122.	24.5	10.4	10.3	5.8	42.4	42.0	23.7
123.	24.2	10.7	10.2	4.3	44.2	42.1	17.8
124.	23.0	8.5	10.3	4.5	36.9	44.8	19.6
125.	21.8	11.1	9.3	3.9	50.9	42.7	17.9
126.	21.7	11.5	11.1	2.8	52.9	51.2	12.9

74. Plesiotype, Renz and Renz (1948: pl. 14, fig. 2), NHMB J13615.
75. Plesiotype, Renz and Renz (1948: pl. 14, fig. 1), NHMB J13614.
76. Plesiotype, Renz and Renz (1948: pl. 14, fig. 3), NHMB J13616.
Remaining specimens from 73–97: unfigured paratypes from Maradovuno, Chios, NHMB J13617.
98. Plesiotype, Renz and Renz (1948: pl. 13, fig. 4), NHMB J13619.
112. Plesiotype, Renz and Renz (1948: pl. 14, fig. 7), NHMB J13620.
Remaining specimens from 99–126 unfigured paratypes from Maradovuno, Chios, NHMB J13621.

(pl. 14, fig. 4) J13597, (pl. 14, fig. 5) J13598, (pl. 14, fig. 8a) NHMB J13599, (pl. 14, fig. 8b) NHMB J13602, (pl. 14, fig. 11) NHMB J13600; unfigured paratypes from Maradovuno NHMB J13603, from Kephalovuno NHMB J13604; holotype, *I. antiglobulus* (pl. 13, fig. 10) NHMB J13605; paratypes (pl. 13, fig. 1) NHMB J13606, (pl. 13, fig. 2) NHMB J13607, (pl. 13, fig. 3) NHMB J13608, (pl. 13, fig. 5) NHMB J13609, (pl. 13, fig. 8) NHMB J13610; unfigured paratypes from Maradovuno NHMB J13612, from Kephalovuno NHMB J13611; syntypes of *I. globulus-originis*, (pl. 13, fig. 6) NHMB J13613, (pl. 14, fig. 1) NHMB J13614, (pl. 14, fig. 2) NHMB J13615, (pl. 14, fig. 3) NHMB J13616; unfigured specimens from Maradovuno NHMB J13617, from Kephalovuno NHMB J13618; syntypes of *I. globulus-antiglobulus*, (pl. 13, fig. 4) NHMB J13619, (pl. 14, fig. 7) NHMB J13620; unfigured specimens from Maradovuno NHMB J13621, from Kephalovuno NHMB J13622; topotypes from Chios MCZ 10019, 10020. The specimens from

Timor are in the British Museum (Natural History).

Isculitoides ellipticus Chao
Text-figure 18

Isculitoides ellipticus Chao, 1959: 119, 293, pl. 26, figs. 24–28, pl. 30, figs. 1–5, text-fig. 38a, b.
Isculitoides aff. *originis* (Arthaber), Chao, 1959: 118, 292, pl. 26, figs. 22, 23.

Chao had one specimen of his *I.* aff. *originis* and four specimens assigned to *I. ellipticus*; for none of the specimens are any measurements given. All the specimens are compressed with rounded venters. The specimen assigned to *I.* aff. *originis* is slightly more evolute than *I. ellipticus*. We have already seen from the abundant material of *I. originis* from Chios that there can be a large amount of intraspecific variation. These Kwangsi specimens could well belong to *I. originis* or *I. hammondi* but the smallness of the sample does not allow a critical comparison. It seems best for the moment to recognize this species with the reservation that it is very close to *I. originis* and could well be conspecific. The sutures are illustrated on Figure 18 J–L.

Occurrence. The four specimens of *I. ellipticus* came from a loose block of limestone, stratigraphic position unknown, from near the Lolou village, Linglo district, Kwangsi, China (Chao collection 542b). Associated forms include species of *Procarnites*, *Proptychitoides*, etc., which indicate a late Scythian *Subcolumbites* age. The single specimen of *I.* aff. *originis* came from the same place.

Isculitoides suboviformis (Kiparisova)
Text-figure 18

Paranannites suboviformis Kiparisova and Krishtofovich, 1954: 21, pl. 11, figs. 4, 5; Kiparisova, 1961: 127, pl. 27, figs. 8, 9, text-figs. 94, 95.
Paranannites aff. *suboviformis* Kiparisova, 1961: 128, pl. 27, figs. 10, 11, text-figs. 96, 97.

This species has an extremely depressed whorl section as in *I. wasserbergi* and differs from that Nevada species mainly in lacking any radial ornamentation. Kiparisova (1961: 127) had only six specimens of this species; additional material may establish that the Nevada species is conspecific with this Siberian form. The suture is shown on Figure 18 M.

Table 32. Measurements of *Isculitoides wasserbergi* n. sp. from the Tobin Formation of Nevada.

	D	W	H	U	W/D	H/D	U/D
1.	14.7	13.8	6.1	3.0	93.9	40.5	20.45
2.	14.1	13.8	6.5	1.8	97.9	46.1	13.8
3.	13.0	11.0	6.1	2.0	84.7	46.9	15.4
4.	13.0	11.4	6.2	2.0	87.6	47.7	15.4?
5.	8.5	8.9	3.5	1.0?	105.2	41.1	11.8?
6.	7.3	8.1	3.7?	?	110.9	50.7?	?
7.	5.6	6.1	2.8	0.6?	108.3	50.0	10.7?

1. Holotype, MCZ 9447 (Pl. 29, figs. 1–3).
2. Paratype, MCZ 9448 (Pl. 29, figs. 4–6).
3. Paratype, MCZ 9449 (Pl. 29, figs. 7, 8).
4, 5, 7. Unfigured paratypes, MCZ 9485.
6. Paratype, MCZ 9450 (Pl. 29, figs. 9, 10).

Occurrence. *Subcolumbites* fauna, Cape Zhitkov and Amur Bay, Primorye Region, Siberia.

Isculitoides minor Tozer

Isculitoides minor Tozer, 1965a: 20, pl. 2, figs. 1–3.

This is an involute *Isculitoides* on the pattern of *I. ellipticus* Chao, *I. suboviformis* Kiparisova, and *I. hammondi* n. sp. The species was based on only three specimens which makes comparisons difficult. It is highly possible that *I. ellipticus*, *I. minor*, and *I. hammondi* are conspecific, but for the moment at least it appears best to tentatively recognize all three species.

Occurrence. Toad Formation, Halfway River area, British Columbia.

Isculitoides wasserbergi n. sp.
Plate 29, figures 1–10; Text-figure 18

Small, tightly involute, globular conchs with highly depressed whorl sections, and excentric umbilici on the outer volutions. There are 13 specimens in the collection, of which 7 are sufficiently well preserved to yield the measurements shown in Table 32. The umbilical shoulder is well rounded, sloping gradually up to the very

broadly arched venter and flanks. The umbilical wall is steep. The conch of most specimens is smooth, except for faint growth lines. On some specimens, as that of Plate 29, figures 1, 2, there are a few narrow, low, rounded ridges extending straight across the venter from one umbilical shoulder to the other. The body chamber is at least one volution in length. The suture is simple, ceratitic with single pronged ventral lobes, a denticulated first lateral lobe lying midway between the ventral lobe and the umbilical shoulder, and a second lateral lobe on the umbilical wall (Fig. 18 N–P).

Isculitoides originis from the *Subcolumbites* faunas of Albania and Chios is extremely variable in conch dimensions, a variability typical of many excentrumbilicate ammonites. *Isculitoides wasserbergi* tends to resemble the more involute and globose variants, but still has a much more depressed whorl section and is more involute. Likewise, even though the Nevada sample is small, there is a suggestion at least that the amount of intraspecific variation is much less than that in *I. originis.*

This new species is most similar to *I. suboviformis* (Kiparisova) from the *Subcolumbites* fauna of the Primorye Region. In fact these two species have the most depressed whorls of any known *Isculitoides.*

Occurrence. Lower part of Tobin Formation, USGS Locality M2562, Pershing County, Nevada; south tip of Tobin Range, Cain Mountain 1:62,500 quad., center NW ¼ sec. 9, T. 26N, R. 39E, 5500 ft. S, 27.5 ft. W from elevation point 5088 on range crest.

Repository. Holotype, MCZ 9447 (Pl. 29, figs. 1–3); paratypes, MCZ 9448 (Pl. 29, figs. 4–6), MCZ 9449 (Pl. 29, figs. 7, 8), MCZ 9450 (Pl. 29, figs. 9, 10); suture specimens MCZ 9626, 9657; unfigured paratypes, MCZ 9485.

Isculitoides hammondi n. sp.
Plate 36, figures 8–13; Text-figure 18

This new species is represented by approximately 40 specimens, most of which are poorly preserved. The conch is subglobular to compressed and smooth. The venter is rounded, merging onto convex lateral areas. The umbilical shoulders are broadly rounded. The umbilicus is very small and markedly excentric on the outer volutions. Because of the weathered nature of most of the specimens, measurements are not possible. The conch, however, varies significantly from depressed forms (e.g. Pl. 36, figs. 11, 12) to compressed forms (e.g. Pl. 36, fig. 10). On the basis of the available specimens there appears to be a complete gradation between these extremes.

The suture is ceratitic with the first lateral lobe on the mid-part of the lateral areas, and a second lateral lobe on the umbilical shoulder (Fig. 18).

This species is quite distinct from *Isculitoides wasserbergi,* which is more depressed and constant in conch form, more evolute, and has at least some ornamentation. *Isculitoides originis* (Arthaber) from Albania and Chios displays a wide range in conch shape from depressed to compressed similar to that of *I. hammondi.* This Tethyan species tends to be more evolute and more markedly excentric than the Idaho species recorded here. The data on *Isculitoides ellipticus* Chao (1959) are limited, but there is a strong similarity to the Idaho species. It is not at all impossible that the Kwangsi and Idaho specimens are conspecific.

Occurrence. Uppermost member of Thaynes Formation, Hammond Creek, Bear River Range, southeast Idaho.

Repository. Holotype, MCZ 9477 (Pl. 36, fig. 8); paratypes MCZ 9478 (Pl. 36, figs. 9, 10), MCZ 9479 (Pl. 36, fig. 11), MCZ 9480 (Pl. 36, figs. 12, 13); unfigured paratypes MCZ 9486.

Genus *Chiotites* Renz and Renz, 1947
Type species, *Prosphingites (Chiotites) globularis* Renz and Renz, 1947

Small, very involute excentrumbilicate

forms, with contracting living chamber; a few prosiradiate constrictions near aperture; whorls depressed with broadly arched venter and rounded shoulders; living chamber bears prominent strigations. Suture with two denticulated lateral lobes, a denticulated auxiliary lobe above the umbilical shoulder and another one below the umbilical shoulder.

In its involute, excentrumbilicate conch this genus is quite similar to *Isculitoides* and *Protropites*, but the sutures of the latter two genera are very different. The suture of *Chiotites* is most similar to that of *Prosphingites* except for the additional auxiliary lobe.

The genus is known from a single species in the *Subcolumbites* fauna of Chios.

Chiotites globularis Renz and Renz
Text-figure 17

Prosphingites (*Chiotites*) *globularis* Renz and Renz, 1947: 60, 74; Renz and Renz, 1948: 40, pl. 15, figs. 9–9c.

Chiotites globularis,—Kummel, *in* Arkell et al., 1957: L139, fig. 172, 11.

Prosphingites (*Chiotites*) *superglobosus* Renz and Renz, 1947: 60, 75; Renz and Renz, 1948: 41, pl. 15, figs. 7–7b, 10.

The species *C. superglobosus* was introduced for the more inflated forms in the Chios fauna from Maradovuno. However, from the numerous paratypes in the Natural History Museum, Basel, it is quite clear that there is a complete gradational series from forms assigned to *globularis* to those placed in *superglobosus*. In their monograph the Renzes record only two specimens for each of their two species. There are in addition a number of specimens in Basel. These additional specimens are for the most part poorly preserved or unprepared. A suture is illustrated on Figure 17D. The measurements of the figured specimens are as follows:

	D	W	H	U	W/D	H/D	U/D
1.	22.2	13.3	8.5	8.7	59.9	38.3	39.2
2.	20.3	13.6	9.9	5.1	67.0	48.8	25.1
3.	21.8	16.8	7.3	5.7	77.1	33.5	26.1
4.	22.6	?	7.8	7.0	?	34.5	31.0

1. Holotype, Renz and Renz (1948: pl. 15, fig. 9), NHMB J13642.
2. Paratype, Renz and Renz (1948: pl. 15, fig. 9c), NHMB J13643.
3. Holotype, *C. superglobosus* Renz and Renz (1948: pl. 15, fig. 7), NHMB J13645.
4. Paratype, *C. superglobosus* Renz and Renz (1948: pl. 15, fig. 10), NHMB J13646.

Occurrence. *Subcolumbites* fauna, Maradovuno, Chios.

Repository. Holotype, NHMB J13642; paratypes NHMB J13643 (Renz and Renz, 1948: pl. 15, fig. 9c); unfigured paratypes from Maradovuno NHMB J13644; holotype *superglobosus* Renz and Renz (1948: pl. 15, fig. 7) NHMB J13645; paratype (Renz and Renz, 1948: pl. 15, fig. 10) NHMB J13646; unfigured paratypes from Maradovuno NHMB J13647.

Genus *Czekanowskites* Diener, 1915
Type species, *Ceratites decipiens* Mojsisovics, 1886

Czekanowskites decipiens (Mojsisovics)

Ceratites decipiens Mojsisovics, 1886: 27, pl. 6, fig. 9.

Czekanowskites decipiens,—Diener, 1915: 115; Spath, 1934: 264; Kummel *in* Arkell et al., 1957: L143, fig. 175, 2; Kummel, 1961: 521.

Ceratites inostranzeffi Mojsisovics, 1886: 28, pl. 6, fig. 10.

Czekanowskites inostranzeffi,—Diener, 1915: 115; Kummel, 1961: 521.

It is unfortunate that in the extensive revision of the Siberian Olenek fauna Popov (1961, 1962a) apparently had no additional specimens of this interesting genus and species. There have been few other records of the species since its introduction by Mojsisovics. The specimen from the *Arctoceras* horizon on Spitsbergen that Frebold (1930) described as *Czekanowskites* (?) sp. nov. does not belong in this genus. Kummel (1954) recorded a fragmentary specimen that probably belongs to this genus and is described below.

Occurrence. *Olenekites* Zone, Olenek River region, Siberia.

Czekanowskites cf. *decipiens* (Mojsisovics)

Czekanowskites? sp. Kummel, 1954: 187.

A fragment consisting of a quarter volu-

tion of living chamber is believed to belong to this genus, which is known from only one species in the upper Scythian strata at the mouth of the Olenek River, Siberia. The adoral part of the fragment measures 19 mm high and 17.5 mm in width. The whorl section is subquadrate in outline with a broad, low arched venter, rounded ventral shoulders, lateral areas that are only slightly convex and convergent, rounded umbilical shoulders, and a steep umbilical wall. The lateral areas bear radial ribs that enlarge slightly towards the ventral shoulders. There is a faint trace of the ribs across the venter, which gives the venter an undulating appearance. The posterior end of this fragment has some traces of the last septum, enough to indicate that there is a large first lateral lobe, adjacent to large rounded saddles. The second lateral lobe is high on the lateral areas and is much smaller, and there is probably a very small auxiliary lobe on the umbilical wall.

This fragment is assigned to *Czekanowskites* on the basis of the great similarity of the whorl outline and pattern of ribs to the Siberian species of this genus. The suture, insofar as it can be observed, is also similar in basic pattern to that of the Siberian species. The major difference appears to be in the nature of the venter. The Siberian species appears to have a smooth venter, whereas the form recorded here has traces of the ribs across the venter.

Occurrence. Upper member of the Thaynes Formation, Hammond Creek, Bear River Range, southeast Idaho.

Repository. MCZ 9649.

Genus *Popovites* Tozer, 1965
Type species, *Popovites occidentalis* Tozer, 1965

"Inner whorls globose, outer whorl of approximately equal height and width, with a perpendicular umbilical wall, prominent, rounded umbilical shoulder, flat sides, and a broadly arched or slightly flattened venter. Sculpture consists of regular growth lines; radial wrinkles or faint ribs may also occur on the venter. Constrictions are absent. Body chamber about one whorl in length. The suture line comprises: a deep external lobe, with incised branches; two ceratitic lateral lobes; a suspensive lobe with one or more auxiliary incisions; and one internal lateral lobe" (Tozer, 1965a: 21).

This new genus shows marked affinities to *Prosphingites,* on the one hand, and to *Czekanowskites,* on the other. The suture of *Popovites* is quite similar to that of *Prosphingites* and at the same time not as elaborate as the suture of *Czekanowskites.* There is, however, in the fairly large size of the first lateral lobe a similarity in the suture of *Popovites* and *Czekanowskites* (Fig. 17E). The general conch form of this new group of ammonites is like that in various species of *Prosphingites* and *Czekanowskites.*

The genus is known by two species from an upper Scythian horizon in British Columbia and Ellesmere Island.

Popovites occidentalis Tozer
Text-figure 17

Popovites occidentalis Tozer, 1965a: 22, pl. 3, figs. 2–12, text-figure 5.

The type species is well illustrated and described by Tozer (1965a, Fig. 17E of this report). It differs from *P. borealis* only in being slightly more involute; however, since that species is based on a single specimen, there is no way of evaluating the significance of this difference. Among the measured specimens of *P. occidentalis* there is only a variation of 5 percent in the diameter of the umbilicus (Tozer, 1965a: p. 23). The umbilical diameter of the holotype of *P. borealis* is 31 percent at a diameter of 31 mm and 35 percent at a diameter of 43 mm. This is 5 and 10 percent, respectively, greater than the maximum diameter of the umbilicus for *P. occidentalis.*

Occurrence. Toad Formation, Halfway River area, British Columbia, associated

with *Preflorianites intermedius* Tozer and *Monacanthites monoceros* Tozer.

Popovites borealis Tozer

Popovites borealis Tozer, 1965a: 24, pl. 3, figs. 1a, b, text-figure 6.

See above for discussion of this species.

Occurrence. Blaa Mountain Formation, lower shale member, Ellesmere Island.

Genus *Monacanthites* Tozer, 1965
Type species, *Monacanthites monoceros* Tozer, 1965

"Globose ammonoids with sculpture of widely spaced, unbranched ribs that are curved to form a sharp ventral sinus. On the outer whorl each rib, at the ventral mid-line, carries a single, solid spine. Body chamber one whorl in length. Suture ceratitic, with two lateral lobes, both internally and externally" (Tozer, 1965a: 27).

Monacanthites monoceros Tozer
Text-figure 17

Monacanthites monoceros Tozer, 1965a: 27, pl. 1, figs. 8–10, pl. 2, fig. 4, text-fig. 8.

A unique species, quite unlike any other ammonite of comparable age (Fig. 17F).

Occurrence. Toad Formation, Halfway River area, British Columbia, associated with *Preflorianites intermedius* Tozer and *Popovites occidentalis* Tozer.

Genus *Tunglanites* Chao, 1959
Type species, *Tunglanites lenticularis* Chao, 1959

Involute, compressed conch with narrowly rounded to acute venter; inner volutions more inflated, bearing oblique constrictions. Body chamber of one volution. Suture with single ceratitic lateral lobe, two rounded lateral saddles.

The combination of conch shape and suture of this genus is unique among late Scythian ammonoids. The group was first recognized from the *Subcolumbites* fauna of Albania by Arthaber (1911) who placed it in the genus *Styrites* of much younger age. This generic assignment for this late Scythian form has never been accepted. Diener (1915: 271) listed it with question in the genus *Styrites*, and Spath (1934: 197) clearly recognized the independent status of this form but refrained from proposing a new generic name, most likely because data on the Albanian forms were very incomplete. Renz and Renz (1948) gave no indication that they were familiar with any literature on this form after the publication of Arthaber's paper in 1911.

The discovery of eight specimens in the *Subcolumbites* fauna of Kwangsi, China, has enabled a much clearer understanding of the group, and a new generic name is well justified.

There are at present two species of the genus *Tunglanites*, *T. lenticularis* Chao, the type species, and *T. alexi* n. sp. for the Albanian and Chios forms assigned to *Styrites lilangensis* Diener by Arthaber and Renz and Renz, respectively. Direct comparison of these two species is handicapped by the incompleteness in our knowledge of the Albanian and Chios specimens. Unfortunately, one of the specimens studied by Arthaber is lost and the Chios fauna has yielded only two specimens. These western Tethyan specimens were thought by both Arthaber and the Renzes to have a goniatitic lateral lobe. However, the preservation, in hard red limestone, makes development of the suture extremely difficult, and the smooth character of the lobe may be due to over grinding or etching. Regardless of this there can be no doubt of the close relationship, and perhaps even identity, of these two species.

In regard to the genetic relations of the group, Spath (1934: 197) suggested they represent a specialized offshoot of *Isculitoides*. The recognition of faint constrictions on the early volutions of the Kwangsi specimens, the compression of the conch, and nature of the suture make this suggestion perfectly reasonable.

In the three localities where *Tunglanites* has been recorded, Albania, Chios, and

Kwangsi, China, the associated fauna includes such typical upper Scythian genera as *Subcolumbites, Proptychitoides,* and *Hemilecanites.*

Tunglanites lenticularis Chao
Text-figure 21

Tunglanites lenticularis Chao, 1959: 120, 294, pl. 27, figs. 25–32, pl. 28, figs. 23–25.

Involute, compressed, small conch with rounded venter on early volutions becoming acute on last volution. Living chamber one volution or more in length. Surface may bear fine striae of growth which curve backward along flanks; constrictions may be present on early volutions. Suture with broad ventral lobe, two rounded lateral saddles and single lateral lobe; occasionally a second lateral lobe is present on the umbilical shoulder and wall.

Chao established his new genus and species on the basis of eight specimens of which three were illustrated. It appears that the umbilicus is completely closed on the earlier volution and gradually opens slightly on the more adoral volutions. The only other recorded occurrence of this genus is that of specimens from Albania and Chios which are very similar in over-all appearance to this Kwangsi species. The western Tethyan specimens have a more open umbilicus at a smaller diameter; however, the significance of this difference is questionable. More material is needed to evaluate the ontogenetic changes in growth. Another distinctive feature is the suture (Fig. 21A). The Chios and Albanian specimens are reported to have smooth lobes. However, the preservation of these specimens in hard red limestone requires grinding and acid to observe the suture in most cases. It is not at all certain that the lobes are really goniatitic. The Albanian specimen described by Arthaber (1911: 260, pl. 23(7), fig. 12) as *Styrites lilangensis* Diener does not show a suture; just where Arthaber obtained the suture of his figure 12c is a puzzle (Fig. 21B). The specimen from Chios described by Renz and Renz (1948: 31, pl. 12, fig. 4) does not show the suture clearly enough to establish whether it is really goniatitic. I strongly suspect that the lateral lobe is indeed denticulated.

Occurrence. From a black, thin bedded limestone 0.6 meters thick and 14 meters above the lower Permian Maokou Limestone (Chao collection 542b); the Chashanao section of Chao (1959: 162) at the border of Hochich and Tunglan districts (Chao collection 610), western Kwangsi, China. The Scythian strata at this locality comprise only about 16 meters of shale and limestone. The only fossils present are from this 0.6 meter bed, which in addition to *Tunglanites* contains *Subcolumbites, Proptychitoides* and *Hemilecanites.*

Tunglanites alexi n. sp.
Plate 20, figures 1, 2; Text-figure 21

Styrites lilangensis,—Arthaber (non Diener), 1911: 260, pl. 23(7), figs. 11a, b, 12a, b, c; Renz and Renz, 1947: 60; Renz and Renz, 1948: 31, pl. 12, figs. 4–4a.

Styrites (?) cf. *lilangensis* Diener, 1915: 271.

Gen. nov. "*Styrites*" *lilangensis*,—Spath, 1934: 189, 197.

This species is established for the specimens Arthaber (1911) and Renz and Renz (1948) described as *Styrites lilangensis* Diener from the *Subcolumbites* faunas of Albania and Chios. Arthaber had two specimens from Albania both of which he illustrated; the smaller of his two specimens (Arthaber, 1911: pl. 23(7), fig. 11) is lost, but the larger specimen (Arthaber, 1911: pl. 23(7), fig. 12) is available and is selected as the type specimen. The diameter of this specimen is approximately 30 mm, the width of the adoral whorl 8.5 mm, the height 12.5 and the diameter of the umbilicus 6.7 mm. A portion of the phragmocone is broken off and missing. The whorls are compressed and convergent, forming an acute venter. The umbilical shoulders are very low but rounded; the umbilicus is excentrumbilicate. Arthaber (1911: pl. 23(7), fig. 12c) shows a suture (Fig. 21B of this report) which presum-

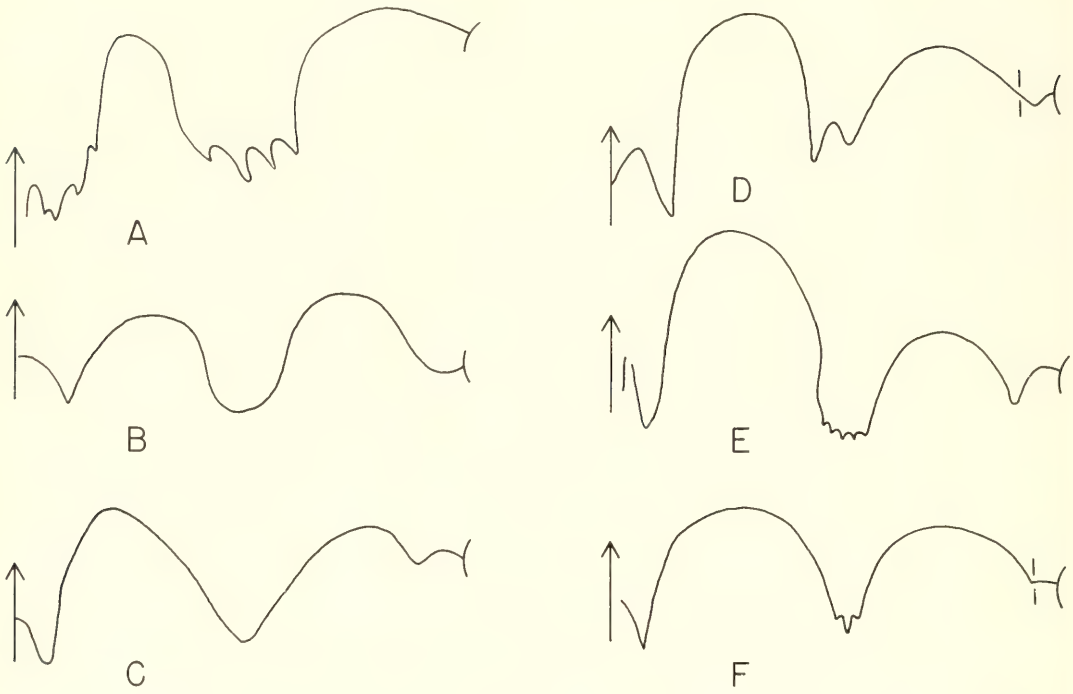


Figure 21. Diagrammatic representation of the suture of: A, *Tunglanites lenticularis* Chao from an upper Scythian horizon in Kwangsi, China (1959: pl. 27, fig. 32), at a diameter of approximately 15 mm; B, *Tunglanites alexi* n. sp. (= *Styrites lilangensis*,—Arthaber, 1911: pl. 23(7), fig. 12c) from *Subcolumbites* fauna of Albania, suture presumably from paratype of Arthaber (1911: pl. 23(7), fig. 11) which is apparently lost; C, *Paradinarites suni* Chao (1950: fig. 4), holotype, at a diameter of approximately 30 mm; D, *Pseudoceltites constrictilis* (Astakhova, 1960: fig. 8) from *Columbites* Zone of Astakhova (1960) on the Mangyshlak Peninsula, at a diameter of approximately 15 mm; E, *Pseudoceltites nevadi* n. sp., from Upper Thaynes Formation, Confusion Range, Utah, un-numbered paratype at whorl height of approximately 10 mm; F, *Pseudoceltites nevadi* n. sp., from Upper Thaynes Formation, Confusion Range, Utah, un-numbered paratype at whorl height of approximately 10 mm.

ably was taken off the other type specimen. Careful examination of this specimen has failed to show any trace of a suture.

The specimen from the *Subcolumbites* fauna of Chios illustrated by Renz and Renz (1948: pl. 12, fig. 4) measures 17.1 mm in diameter, 5.2? mm for the width of the adoral whorl, 7.0 mm for the height of the adoral whorl and 3.5 mm for the diameter of the umbilicus. Renz and Renz state that their Chios specimen had a goniatitic suture; however, my examination of the specimen reveals that the suture is not well preserved and it cannot be established whether it is goniatitic or not. I strongly suspect that the lateral lobe is indeed denticulated.

The general shape of the conch is very much like that of *T. lenticularis* except for an apparently slightly larger umbilicus.

Occurrence. *Subcolumbites* fauna of Albania and Chios.

Repository. Holotype (Pl. 20, figs. 1, 2), Paleontological Institute, University of Vienna; specimens from Chios NHMB J13582 (Renz and Renz, 1948: pl. 12, fig. 4), unfigured specimen NHMB J13583.

Genus *Columbites* Hyatt and Smith, 1905

Type species, *Columbites parisianus* Hyatt and Smith, 1905

Columbites parisianus Hyatt and Smith

Plate 39, figures 1–10; Plate 40, figures 1–11; Plate 41, figures 1–7;

Plate 42, figures 1–9; Plate 43, figures 4, 5; Text-figures 22, 23.

Columbites parisianus Hyatt and Smith, 1905: 51, pl. 1, figs. 9–14, pl. 61, figs. 1–21, pl. 72, figs. 1–24; Frech, 1908: pl. 42, fig. 2; Diener, 1915: 112; Diener, 1925: 69, pl. 24, fig. 2; Smith, 1932: 107, pl. 1, figs. 9–14, pl. 61, figs. 1–21, pl. 72, figs. 1–24; Spath, 1934: 201, pl. 13, fig. 3, text-fig. 61; Kummel, *in* Arkell, et al., 1957: L140, fig. 172, 2.

Columbites spencei Smith, 1914: 36, pl. 70, figs. 1–16, pl. 71, figs. 1–16; Smith, 1932: 108, pl. 77, figs. 1–21, pl. 78, figs. 1–16; Kutassy, 1933: 490.

Columbites consanquincus Smith, 1932: 106, pl. 46, figs. 1–13.

Columbites minimus Smith, 1932: 106, pl. 47, figs. 9, 10.

Columbites ligatus Smith, 1932: 106, pl. 47, figs. 1–8.

Columbites ornatus Smith, 1932: 107, pl. 46, figs. 14–21.

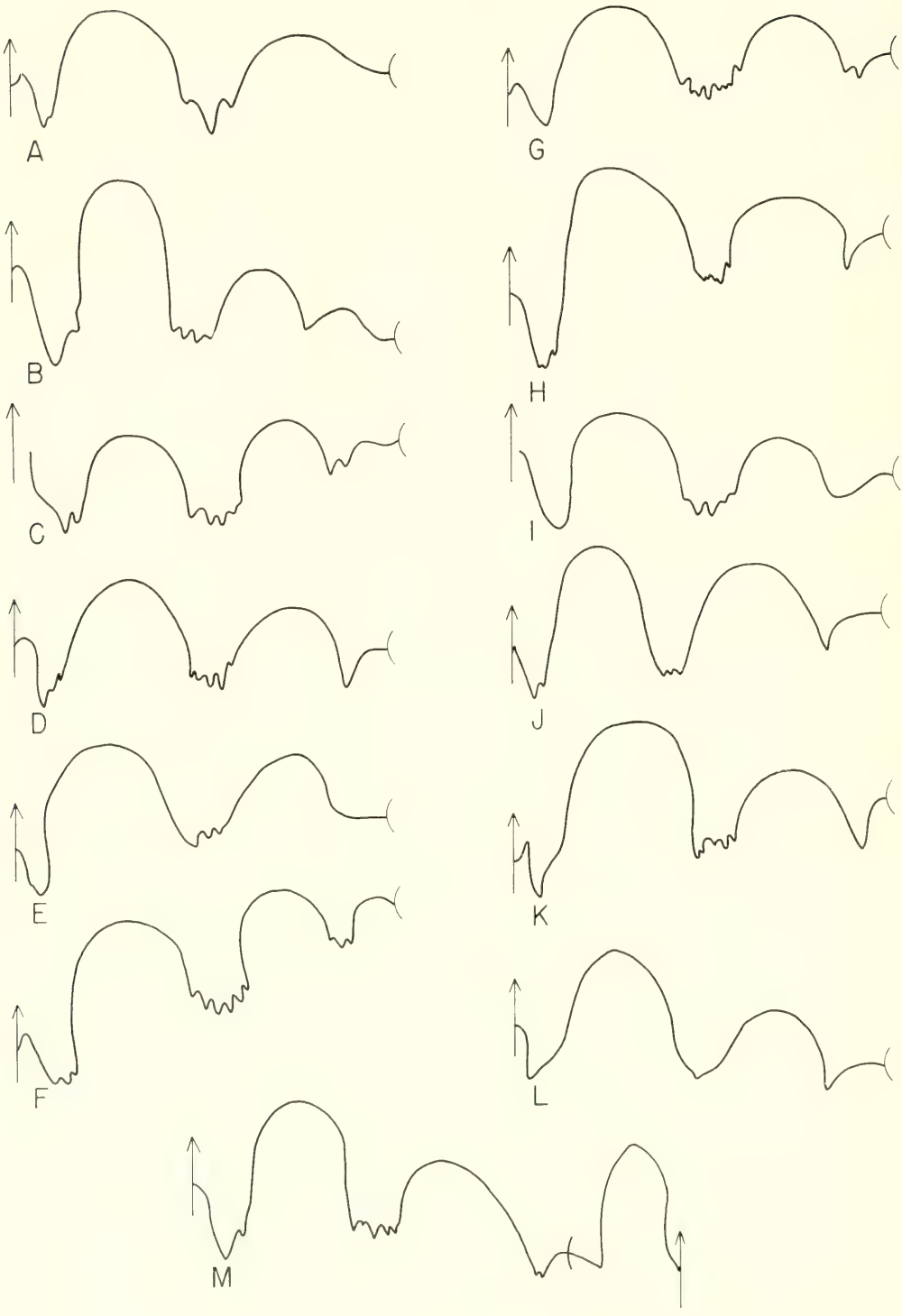
All the specimens assigned to the six species of *Columbites* by J. P. Smith came from outcrops of the middle shale member of the Thaynes Formation (*Columbites* fauna) in Paris Canyon, southeast Idaho. The original description of the type species by Hyatt and Smith (1905), later slightly enlarged by Smith (1932), is quite adequate. The five additional "species" introduced by Smith in 1932 were distinguished on differences in whorl dimensions and on ornamentation. On Table 33 are given the measurements of 107 specimens of *Columbites* from the same horizon, at three localities around the north end of Bear Lake (including Paris Canyon), southeast Idaho. These data are plotted on Figure 23. It can readily be seen from this large sample that slight differences in conch dimensions are meaningless. The differences in ornamentation are more difficult to quantify. But here again, as with most ornamented ammonites, there is complete gradation from very weak ribs to strong ribs; within this species there is also an ontogenetic variable, that is, successive patterns of ribs appear in differing orders. All of these features, however, are completely gradational. Close study of the specimens figured here will bring this fact out.

Smith (1932) did not make particular note of the suture of his six species but this feature is also quite variable. On Figure 22 are 13 sutures of *Columbites*. As can be seen, the variation is expressed in the shape and size of the first and second lateral lobe and thus also in the saddles.

There are no other well authenticated species of *Columbites* recorded to date. *Columbites* sp. described by Kiparisova (1961:119) from an uncertain horizon (*Columbites* Zone?) in the Scythian of the Primorye Region is based on a single poorly preserved specimen. It is possible this is a species of *Columbites*, but it is much more involute than *C. parisianus*. At the same time it could well be a species of *Pseudoceltites*. From northern Siberia, Popov (1961) has described two species of *Columbites*, *Columbites* (?) aff. *ornatus* Smith and *Columbites morpheos* Popov. The first of these records is based on two poorly preserved casts showing no suture; I believe these to be unidentifiable. The second, *C. morpheos*, is a species of *Tirolites* and is discussed under that genus in this paper. Finally, there are *Columbites dolnapaensis* Kiparisova (1947: 143) and *Columbites constrictilis* Astakhova (1960: pl. 140) from the Mangyshlak Peninsula of southern Russia. These two species belong in *Pseudoceltites* and are discussed under that genus. *Columbites parisianus* is thus far only known from southeast Idaho.

Occurrence. Middle shale member, Thaynes Formation, *Columbites* fauna at Paris Canyon, Montpelier Canyon, and Hot Springs, all around north end of Bear Lake, southeast Idaho, and same horizon along Draney Creek, Stewart Flat Quadrangle, southeast Idaho (USGS locality M98).

Repository. Holotype (Pl. 39, figs. 3, 4) USNM 75246a; paratypes (Pl. 39, figs. 8, 9) USNM 75246b, (Pl. 41, fig. 7) USNM 75286a, (Pl. 39, figs. 1, 2) USNM 75286b, (Pl. 39, figs. 5–7) USNM 75286c, (Smith,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1932, pl. 61, figs. 8, 9) USNM 75286d, (Pl. 39, fig. 10) USNM 75286e; all the remaining small juvenile specimens of this species studied by Hyatt and Smith (1905) and Smith (1932) are in the U.S. National Museum but are not formally numbered; suture specimens of Figure 22, MCZ 9532–9538; specimens from Montpelier Canyon MCZ 9633, from Hot Springs 9634; from Draney Creek, Stewart Flat Quadrangle, southeast Idaho, USGS; holotype *C. consanquineus* Smith, (Pl. 41, figs. 1, 2) USNM 74983a; paratypes (Pl. 41, figs. 3, 4) USNM 74983b, (Pl. 41, figs. 5, 6) USNM 74983c, (Smith, 1932: pl. 46, figs. 7–9) USNM 74983d, (Smith, 1932: pl. 46, figs. 10–13) USNM 74983e; holotype *C. ligatus* Smith, (Pl. 43, figs. 4, 5) USNM 74985a; paratypes (Pl. 42, fig. 7) USNM 74985b, (Pl. 40, figs. 7–9) USNM 74985c; holotype *C. minimus* (Smith, 1932: pl. 47, figs. 9, 10) USNM 74986; holotype *C. ornatus* Smith, (Pl. 40, figs. 1, 2) USNM 74984a; paratypes (Pl. 40, figs. 10, 11) USNM 74984b, (Smith, 1932: pl. 46, figs. 19–21) USNM 74984c; holotype *C. spencei* Smith (Pl. 42, figs. 1, 2) USNM 75309; paratypes (Smith, 1932: pl. 78, fig. 3) USNM 75309b, (Pl. 42, figs. 3, 4) USNM 75309c, (Pl. 42, figs. 8, 9) USNM 75309d, (Pl. 42, figs. 5, 6) USNM 75309e, (Pl. 40, figs. 5, 6) USNM 75309f, (Pl. 40, figs. 3, 4) USNM 75309g, specimens of Smith (1932: pl. 77, figs. 1–21) USNM 75309h–i.

Genus *Subcolumbites* Spath, 1930
Type species, *Columbites perrinismithi* Arthaber, 1908

The most common elements in many late Scythian faunas are species of *Subcolumbites*. The five species of this genus recognized to date can be separated into three distinct groups. The first group contains only the type species, which is known from Albania, Chios, China, and Japan, and is characterized by carination of the venter. The second group contains only *S. dusmani*, and is characterized by a more marked development of reticulate ornamentation. The third group contains *S. robustus* from China, *S. multiformis* from the Primorye Region, and *S. americanus* from Nevada. This third group is characterized by a more depressed whorl section.

Subcolumbites perrinismithi (Arthaber)
Plate 1, figures 1–9; Plate 2, figures 5–8; Plate 3, figures 1–9; Plate 4, figures 1–4; Text-figure 24

Columbites perrini-smithi Arthaber, 1908: 277, pl. 12, fig. 1; Arthaber, 1911: 262, pl. 23(7), figs. 19, 20; Diener, 1915: 112; C. Renz, 1928: 155; Renz and Renz, 1947: 59; Renz and Renz, 1948: 20, pl. 11, figs. 7–7a.

Subcolumbites perrini-smithi,—Spath, 1930: 77; Spath, 1934: 203, pl. 12, figs. 5a, b; Kummel, *in* Arkell et al., 1957: L140, figs. 172, 15a, b; Kummel, 1968b: 495, pl. 1, figs. 1–3.

Columbites europaeus Arthaber, 1908: 278, pl. 12, fig. 2; Arthaber, 1911: 261, pl. 23(7),

←

Figure 22. Diagrammatic representation of the sutures of *Columbites parisianus* Hyatt and Smith. A, suture of holotype at a diameter of 35 mm (USNM 75246a), from Smith (1932: pl. 1, fig. 11); B, at a diameter of 35 mm (USNM 75286b), from Smith (1932: pl. 61, fig. 4); C, suture of holotype of *C. ligatus* Smith (1932: pl. 47, fig. 3), at a diameter of 40 mm (USNM 74985a); D, at a diameter of 46.7 mm (MCZ 9532); E, at a diameter of 22.3 mm (MCZ 9533); F, paratype of *C. spencei* Smith (1932: pl. 78, fig. 4), at an approximate diameter of 35 mm (USNM 75309b); G, paratype of *C. consanguineus* Smith (1932: pl. 46, fig. 4), at a diameter of approximately 40 mm (USNM 74983b); H, at a diameter of 42.0 mm (MCZ 9534); I, paratype of *C. ornatus* Smith (1937: pl. 46, fig. 18), at a diameter of 25 mm (USNM 74984b); J, at a diameter of 28.6 mm (MCZ 9535); K, at a diameter of 33.7 mm (MCZ 9536); L, at a diameter of 23.0 mm (MCZ 9537); M, at a whorl height of 10 mm (MCZ 9538). All specimens from *Columbites* fauna, Thaynes Formation, southeast Idaho; A, B, C, F, G, I, are from Paris Canyon, the remaining specimens from Hot Springs.

TABLE 33. MEASUREMENTS OF *COLUMBITES PARISIANUS* HYATT AND SMITH FROM *COLUMBITES* FAUNA FROM THREE LOCALITIES AROUND NORTH END OF BEAR LAKE, SOUTHEAST IDAHO.

	D	W	H	U	W/D	H/D	U/D		D	W	H	U	W/D	H/D	U/D
1.	67.9	17.3	18.4	34.8	25.5	27.1	51.4	41.	40.3	?	10.8	20.4	?	27.0	50.5
2.	66.2	16.0	19.5	32.2	24.2	29.4	49.4	42.	39.4	12.0	10.5	20.8	30.5	26.7	52.8
3.	65.0	16.5	18.8	31.8	24.4	39.0	49.0	43.	39.0	11.4	11.9	17.7	29.2	30.5	45.5
4.	63.0	16.0	19.4	27.4	25.4	30.8	43.5	44.	38.7	11.0	12.5	16.5	28.4	32.3	42.7
5.	62.5	16.9	16.7	30.4?	27.1	26.7	54.4?	45.	38.3	11.0	11.7	18.6	28.7	30.6	48.6
6.	61.7	15.3	20.6	25.9	24.8	33.4	42.0	46.	37.8	11.9	12.0	17.8	31.5	31.7	47.1
7.	59.7	15.0	19.1	25.0	25.1	32.0	41.9	47.	37.6	11.9	11.3	17.8	31.6	30.1	47.4
8.	59.0	15.4	16.1	29.5	25.8	26.9	49.3	48.	37.3	11.9	10.0	18.5	31.9	26.8	49.6
9.	58.7	15.8	15.0	32.7	27.1	25.5	55.6	49.	36.7	11.8	9.4	18.7	32.2	25.1	51.0
10.	58.5	16.6	16.4	30.2	28.4	28.1	51.6	50.	36.4	12.0	10.3	17.8	33.0	27.5	48.9
11.	58.3	16.7	18.4	28.3	28.6	31.6	48.6	51.	35.8	10.6	10.1	17.5	30.5	28.2	48.9
12.	56.5	17.3?	15.6	29.0	30.6?	27.6	51.3	52.	35.7	11.4	10.1	18.0	31.9	28.3	50.5
13.	54.5	14.2	17.1	24.2	26.1	31.4	44.4	53.	35.6	11.2	10.3	18.4	31.3	28.9	50.6
14.	54.0	15.5?	17.2	23.7	28.7?	31.9	43.9	54.	35.3	13.3	9.3	18.5	37.7	26.3	52.4
15.	54.0	14.4	17.4	25.3	26.7	32.3	46.9	55.	35.0	10.5	9.8	16.4	30.0	28.0	46.9
16.	53.5	15.4	15.0	27.8	28.8	28.0	52.0	56.	33.8	12.7	8.8	17.8	37.6	26.0	52.7
17.	52.4	15.7	14.3	26.1	30.0	27.3	49.8	57.	33.4	10.5	9.2	17.3	31.5	27.5	51.8
18.	50.7	14.4	14.0	25.8	28.4	27.8	50.8	58.	33.2	9.7	11.1	14.5	29.2	33.4	43.7
19.	50.5	14.0	15.0	24.3	27.7	29.7	48.1	59.	32.1	10.5	10.0	15.0	32.7	31.2	46.7
20.	50.5	14.7	13.5	27.3	29.2	26.7	54.1	60.	31.4	11.7	8.9	16.1	37.3	28.3	51.3
21.	49.8	12.8	15.5	23.4	25.7	31.2	47.0	61.	31.4	11.0	11.2	12.5	35.0	35.7	39.9
22.	49.7	?	14.8	24.7	?	29.7	49.5	62.	30.9	13.9	8.4	16.2	45.0	27.2	52.5
23.	49.4	15.8	13.8	25.2	32.0	28.0	50.6	63.	30.8	11.3	10.5	13.0	36.9	34.1	42.3
24.	49.0	13.7	15.0	20.8	27.9	30.6	42.4	64.	30.5	10.8	7.5	16.2	34.8	24.6	53.2
25.	48.7	15.0	12.5	27.8	30.7	25.6	56.9	65.	30.3	11.5	10.2	13.2	38.0	33.6	43.6
26.	48.4	13.4	16.3	21.1	27.7	33.7	43.6	66.	29.0	10.0	8.7	13.7	34.5	30.0	47.3
27.	48.2	9.4	12.9	24.4	19.5	26.7	50.6	67.	29.0	10.0	7.7	15.0	34.5	26.5	51.7
28.	48.2	13.7	13.7	23.1	28.4	28.4	48.0	68.	28.8	11.1	8.7	9.1	38.6	30.2	39.1
29.	48.0	14.3	12.5	24.8	29.8	26.1	51.6	69.	28.7	10.6	8.2	15.0	36.9	28.6	52.3
30.	47.8	14.7	13.7	24.7	30.8	28.7	51.6	70.	28.5	10.8	8.0	14.4	37.8	28.1	50.6
31.	47.7	14.0	12.7	25.4	29.4	26.6	53.3	71.	28.0	11.7	9.1	13.0	42.3	32.5	46.4
32.	46.6	15.0	14.4	23.4	32.2	30.9	50.2	72.	27.0	9.6	7.3	12.5	35.5	27.0	46.3
33.	44.2	13.3	13.5	21.0	30.1	30.6	47.6	73.	26.4	10.0	7.0	14.0	37.9	26.5	53.0
34.	43.7	11.9	13.4	20.0	27.3	30.7	45.8	74.	26.1	11.0	7.2	13.8	42.2	38.7	55.0
35.	43.0	12.3	12.0	22.8	28.6	27.9	53.0	75.	26.0	9.7	9.4	11.8	37.2	36.2	45.4
36.	42.7	13.5	11.7	22.1	31.6	27.4	51.8	76.	25.3	9.4	7.3	13.3	37.1	28.8	52.5
37.	42.3	11.1	13.5	18.2	26.2	31.9	43.0	77.	25.0	10.7	7.0	12.8	42.8	28.0	51.3
38.	41.5	11.5	11.4	19.6	27.7	27.5	47.2	78.	24.6	9.5	8.4	10.9	38.8	34.1	44.3
39.	41.5	12.3	12.4	21.3	29.6	29.9	51.4	79.	24.5	10.5	7.0	13.0	42.9	28.5	53.1
40.	41.0	10.9	12.8	18.7	26.6	31.2	45.6	80.	24.3	11.5	9.2	10.3	47.3	27.9	42.4

2. Plesiotype, Smith (1932: pl. 61, fig. 1), USNM 75286a.
3. Holotype, *C. ligatus* Smith (1932: pl. 47, figs. 1–3), USNM 74985a.
6. Paratype, *C. consanguineus* Smith (1932: pl. 46, fig. 3), USNM 74983b.
7. Holotype, *C. consanguineus* Smith (1932: pl. 46, figs. 1, 2), USNM 74983a.
11. Holotype, *C. spencei* Smith (1932: pl. 78, figs. 1, 2), USNM 75309a.
13. Holotype, *C. ornatus* Smith (1932: pl. 46, figs. 14, 15), USNM 74984a.
15. Plesiotype, Smith (1932: pl. 61, figs. 2–4), USNM 75286b.
26. Plesiotype, Smith (1932: pl. 61, figs. 5–7), USNM 55286c.
40. Holotype, Smith (1932: pl. 1, figs. 9–11), USNM 75246a.
45. Paratype, *C. ligatus* Smith (1932: pl. 47, figs. 4, 5), USNM 74985b.
46. Paratype, *C. spencei* Smith (1932: pl. 78, figs. 5, 6), USNM 75309c.
59. Paratype, *C. ligatus* Smith (1932: pl. 47, figs. 6–8), USNM 74985c.
61. Plesiotype, Smith (1932: pl. 61, figs. 8, 9), USNM 75286d.
63. Paratype, Smith (1932: pl. 1, figs. 12–14), USNM 75246b.
65. Paratype, *C. spencei* Smith (1932: pl. 78, figs. 7, 8), USNM 75309d.
78. Paratype, *C. ornatus* Smith (1932: pl. 46, figs. 16–18), USNM 74984b.
80. Paratype, *C. spencei* Smith (1932: pl. 78, figs. 9, 10), USNM 75309c.

TABLE 33. *Continued.*

	D	W	H	U	W/D	H/D	U/D		D	W	H	U	W/D	H/D	U/D
81.	23.7	10.0	7.2	10.3	42.2	30.1	43.5	95.	14.3	7.0	4.6	5.7	48.9	32.2	39.8
82.	23.0	10.0	8.0	9.4	43.5	34.8	40.7	96.	14.3	7.8	5.1	6.4	54.5	35.6	44.7
83.	22.8	9.4	6.5	11.1	41.2	28.5	48.7	97.	13.8	8.0	4.7	6.5	58.0	34.0	47.1
84.	22.7	9.8	6.5	10.7	43.2	28.6	47.2	98.	13.5	7.0	5.0	5.2	56.0	37.0	38.5
85.	22.7	9.3	6.5	11.2	40.9	28.6	49.3	99.	13.0	4.0	4.0	6.7	30.8	30.8	51.5
86.	22.2	11.8	6.7	10.2	53.3	30.2	46.0	100.	11.4	4.9	3.8	4.5	43.0	33.3	39.4
87.	21.9	9.4	8.3	8.5	42.9	37.8	38.8	101.	10.6	6.6	3.7	4.8	62.2	34.9	45.3
88.	21.8	10.4	6.2	10.0	47.7	28.4	45.9	102.	9.7	5.5	3.5	3.7	56.7	36.1	37.8
89.	20.5	9.8	6.0	10.8	47.8	29.3	52.7	103.	9.5	5.5	3.5	4.1	58.0	36.9	43.2
90.	19.3	9.2	5.8	9.3	47.6	30.1	48.2	104.	8.8	6.1	3.2	3.5	69.2	36.4	39.8
91.	18.7	9.5	7.2	8.2	50.8	38.4	43.8	105.	8.4	5.1	3.0	2.8	60.7	35.7	33.3
92.	17.0	8.8	4.7	8.4	51.7	27.6	49.4	106.	8.0	4.5	2.8	3.6	56.3	35.1	45.0
93.	15.8	7.3	4.3	7.3	46.2	27.2	46.2	107.	7.2	4.4	2.5	2.3	61.1	34.7	32.0
94.	15.3	7.5	5.2	6.7	49.0	34.0	33.8								

81. Paratype, Smith (1932: pl. 61, figs. 11–13), USNM 75286f.
82. Paratype, *C. spencei* Smith (1932: pl. 78, figs. 13–16), USNM 75309g.
87. Paratype, *C. consanguineus* Smith (1932: pl. 46, figs. 5, 6), USNM 74983c.
91. Paratype, *C. spencei* Smith (1932: pl. 78, figs. 11, 12), USNM 75309f.
94. Paratype, Smith (1932: pl. 61, figs. 14, 15), USNM 75286g.
96. Paratype, Smith (1932: pl. 72, figs. 22–24), USNM 75286q.
97. Paratype, *C. spencei* Smith (1932: pl. 77, figs. 1–4), USNM 75309h.
98. Paratype, *C. consanguineus* Smith (1932: pl. 46, figs. 7–9), USNM 74983d.
99. Holotype, *C. minimus* Smith (1932: pl. 47, figs. 9, 10), USNM 74986.
100. Paratype, *C. ornatus* Smith (1932: pl. 46, figs. 19, 20), USNM 74984c.
101. Paratype, *C. spencei* Smith (1932: pl. 77, figs. 5–8), USNM 75309i.
102. Paratype, Smith (1932: pl. 61, figs. 16–18), USNM 75286h.
103. Paratype, Smith (1932: pl. 72, figs. 19–21), USNM 75286p.
104. Paratype, *C. spencei* Smith (1932: pl. 77, figs. 9012), USNM 75309k.
105. Paratype, *C. consanguineus* Smith (1932: pl. 46, figs. 10–13), USNM 74983e.
106. Paratype, Smith (1932: pl. 72, figs. 16–18), USNM 75309o.
107. Paratype, *C. spencei* Smith (1932: pl. 77, figs. 13–15), USNM 75309l.

All other specimens are from the *Columbites* fauna of Paris Canyon, Montpelier Canyon, and Hot Springs, around north end of Bear Lake, southeast Idaho.

figs. 13–18; Diener, 1915: 112; C. Renz, 1928: 155; Renz and Renz, 1947: 59; Renz and Renz, 1948: 19, pl. 11, figs. 3–3a, 4–4a, 5–5a, 6–6a.

Subcolumbites europaeus,—Spath, 1934: 204, pl. 12, figs. 6a, b, text-fig. 62c.

Columbites europaeus-perrini-smithi Renz and Renz, 1947: 59; Renz and Renz, 1948: 20, pl. 11, figs. 1–1b, 2–2b.

Columbites mirditensis Arthaber, 1911: 263, pl. 24(8), figs. 2, 3, 4; Diener, 1915: 112; C. Renz, 1928: 155; Renz and Renz, 1947: 59; Renz and Renz, 1948: 21.

Subcolumbites mirditensis,—Spath, 1934: 205.

Subcolumbites kwangsianus Chao, 1959: 128, 304, pl. 30, figs. 14–17, text-fig. 41c.

Columbites asymmetricus Chao, 1959: 127, 303, pl. 30, figs. 10–13.

Subcolumbites cf. *perrinismithi*,—Bando, 1964a: 99, pl. 3, figs. 18, 19, pl. 4, fig. 3.

Arthaber (1908, 1911) had 70 specimens from the Kčira, Albania, fauna that he assigned to four species of *Columbites*. Of this original collection there are available today only 16 specimens, most of which were illustrated by Arthaber. The unretouched photographs reproduced here clearly demonstrate the poor preservation of these Albanian specimens, and that Arthaber's illustrations are highly retouched.

Both Arthaber (1911) and Spath (1934) recognized the gradational nature of the "species" established for these Albanian forms. Three of these so-called species (*S. europaeus*, *S. perrinismithi*, and *S. mirditensis*) vary mainly in the degree of compression of the whorls. As the whorls become more compressed the umbilical shoulder is more rounded, as the whorls become more depressed the umbilical shoulder becomes more acutely rounded. *Subcolumbites perrinismithi* is the more compressed form, *S. mirditensis* the more

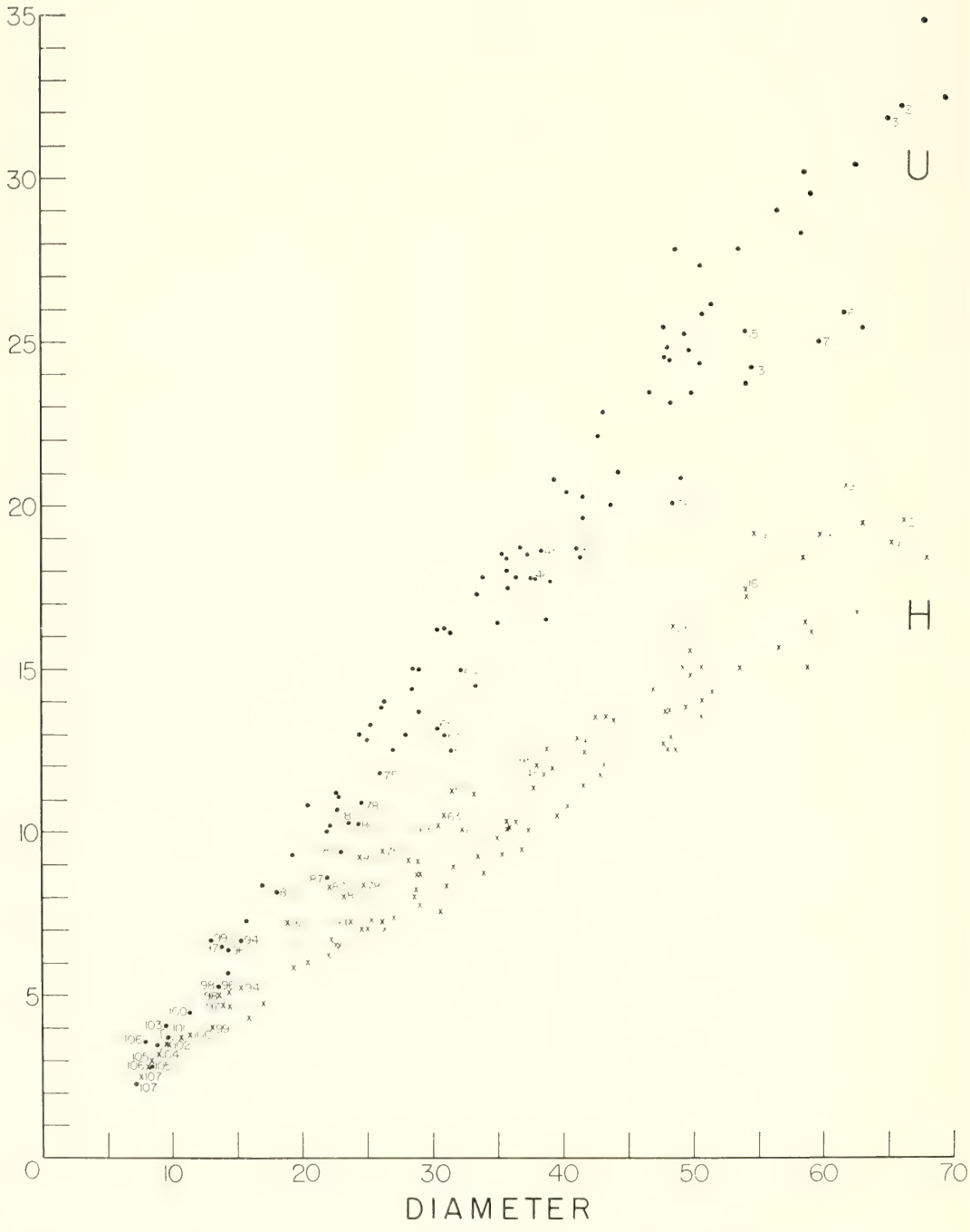


Figure 23. Variation in whorl height (H) and umbilical diameter (U) in *Columbites parisianus* Hyatt and Smith from *Columbites* Zone, Thaynes Formation, southeast Idaho. The data on this graph are from Table 33.

depressed form. Restudy of the available specimens from Kčira, conspecific forms from Chios, and topotypes of the Kčira forms in the British Museum (Natural History) clearly show that there is complete gradation in the degree of compression of the whorls. The measurements of the types available from Kčira and Chios are given on Table 34. The sutures of S. *mirditensis* and S. *europaeus* are illustrated on Figures 24A, B.

The pattern and intensity of ornamentation is also quite variable. In terms of the forward projecting ribs, they range from the fine, regular pattern, as illustrated by S. *perrinismithi* (Pl. 3, figs. 6, 7), to one where in the adoral volutions the ribs are bunched, especially on the venter, forming chevrons (Pl. 1, figs. 7, 8).

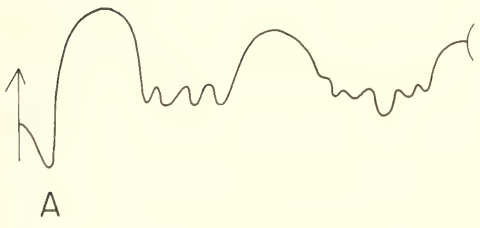
Among the four species established by Arthaber (1908, 1911), there is one (S. *dusmani*) which is quite distinct from the other three. Arthaber had only two specimens, both of small size and poor preservation. This species differs from S. *perrinismithi*, as interpreted here, in lack of a tendency toward carination of the venter and in the more conspicuous reticulate ornamentation. I cannot agree at all that this form is "scarcely more than a variety of S. *europaeus*" (Spath, 1934: 205). This conclusion is strengthened by the discovery of better preserved conspecific forms on Chios and other species of this general ornamentational pattern from Kwangsi, China, and Nevada.

Subcolumbites kwangsianus Chao (1959) was established for two poorly preserved specimens from Kwangsi, China. Though very poorly preserved, the whorl shape, carination of the venter, and ornamentation are like those features in S. *perrinismithi* of Albania and Chios. Chao (1959: 304) recognized the affinities of his species to the Albanian forms but concluded that the elliptical coiling of his species served to distinguish it. The so-called elliptical coiling is no more than that apparent in some of the poorly preserved Albanian specimens of S. *perrinismithi* (Pl. 1, figs. 3, 9). *Subcolumbites kwangsianus* is considered to be a synonym of S. *perrinismithi*. The two specimens from Japan recorded by Bando (1964a: 99) as *Subcolumbites* cf. *perrinismithi*, though poorly preserved, are surely conspecific with this species. The

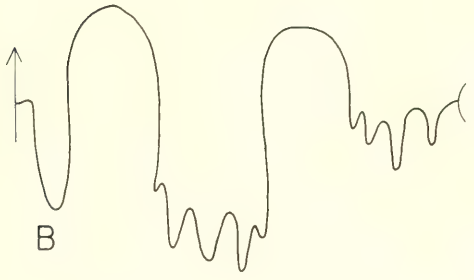
TABLE 34. MEASUREMENTS OF *SUBCOLUMBITES PERRINISMITHI* (ARTHABER) FROM ALBANIA AND CHIOS.

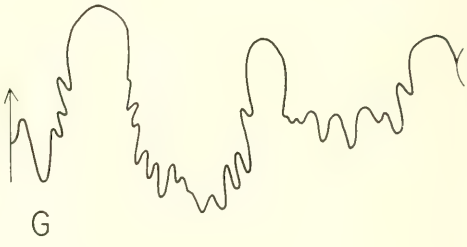
	D	W	H	U	W/D	H/D	U/D
1.	60.4	17.5	19.0	28.7	28.9	31.5	47.5
2.	58.0	16.8	17.5	27.5	28.9	30.2	47.4
3.	55.0	17.7	17.2	23.1	32.2	31.3	42.0
4.	54.4	18.1	20.0	24.6	33.3	36.8	45.2
5.	53.7	13.0	17.4	23.8	24.2	32.4	44.3
6.	52.3	17.2?	16.6	24.2	32.9?	31.7	46.3
7.	49.3	?	14.4	22.8	?	29.2	46.2
8.	48.8	?	13.6	23.9	?	27.9	48.9
9.	47.5	?	16.0	22.0	?	33.7	46.3
10.	46.0	?	15.0	21.3	?	32.6	46.3
11.	43.5	?	14.7	20.0	?	33.8	45.9
12.	40.7	15.4	14.1	18.3	37.8	34.6	44.9
13.	37.0	?	13.0	16.3	?	35.1	44.1
14.	34.4	?	11.8	15.7	?	34.3	45.6
15.	34.3	15.1?	11.2	14.8	44.0?	32.7	43.1
16.	28.3	11.7	10.3	12.0	41.3	36.4	42.4
17.	27.3	14.1	10.1	9.7	51.6	36.9	35.5

1. Plesiotype, *Columbites europaeus* Arthaber (1911: pl. 23(7), figs. 18a, b), PIUV.
2. Plesiotype, *Columbites europaeus-perrini-smithi* Renz and Renz (1948: pl. 11, figs. 1, 1a), NHMB J13538.
3. Plesiotype, *Columbites europaeus-perrini-smithi* Renz and Renz (1948: pl. 11, figs. 2, 2a), NHMB J13539.
4. Plesiotype, *Columbites europaeus* Arthaber (1911: pl. 23(7), figs. 15a, b), PIUV.
5. Plesiotype (Arthaber, 1911: pl. 23(7), figs. 20a, b), PIUV.
6. Plesiotype, *Columbites europaeus*,—Renz and Renz (1948: pl. 11, figs. 3–3a), NHMB J13533.
7. Plesiotype, *Columbites perrini-smithi*,—Renz and Renz (1948: pl. 11, figs. 7, 7a), NHMB J13537.
8. Plesiotype, *Columbites europaeus*,—Renz and Renz (1948: pl. 11, figs. 4, 4a), NHMB J13534.
9. Paratype, *Columbites mirditensis* Arthaber (1911: pl. 24(8), figs. 3a, b), PIUV.
10. Holotype (Arthaber, 1908: pl. 12, figs. 1a–c), PIUV.
11. Plesiotype (Arthaber, 1911: pl. 23(7), figs. 19a, b), PIUV.
12. Plesiotype, *Columbites europaeus* Arthaber (1911: pl. 23(7), figs. 16a, b), PIUV.
13. Holotype, *Columbites mirditensis* Arthaber (1911: pl. 24(8), figs. 2a, b), PIUV.
14. Paratype, *Columbites mirditensis* Arthaber (1911: pl. 24(8), figs. 4a, b), PIUV.
15. Plesiotype, *Columbites europaeus*,—Renz and Renz (1948: pl. 11, figs. 5, 5a), NHMB J13535.
16. Plesiotype, *Columbites europaeus* Arthaber (1911: pl. 23(7), figs. 13a–c), PIUV.
17. Plesiotype, *Columbites europaeus*,—Renz and Renz (1948: pl. 11, figs. 6, 6a), NHMB J13536.


A

F


B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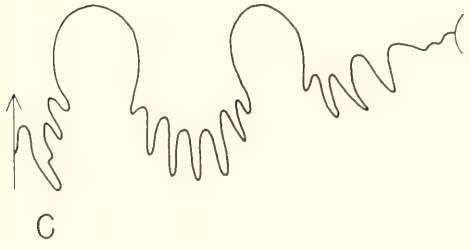
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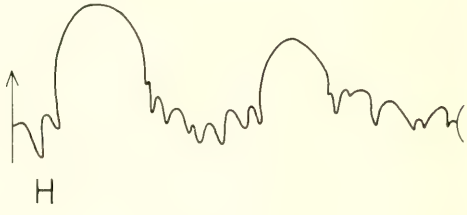
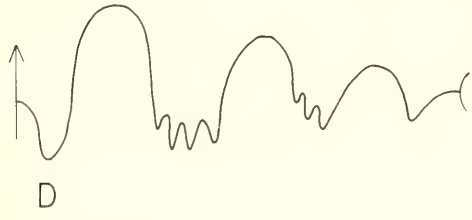

H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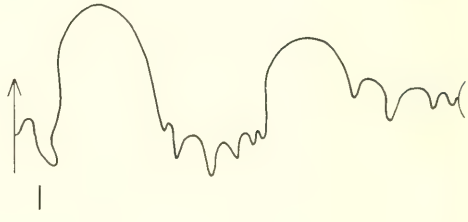
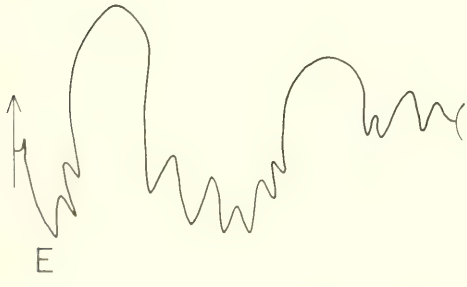

I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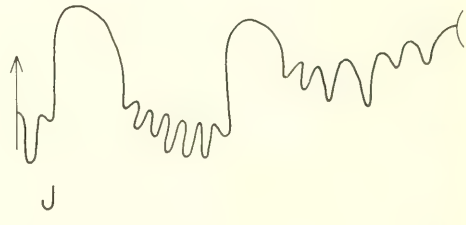

J

sutures of these species are shown on Figures 24A, B, E, J.

Occurrence. *Subcolumbites* faunas of Albania, Chios, Afghanistan, China, and Japan.

Repository. The following specimens are in the Paleontological Institute, Vienna: holotype *Columbites perrini-smithi* Arthaber, 1908: pl. 12(2), figs. 1a–c (Pl. 4, figs. 1, 2 of this report); topotype, *Columbites perrini-smithi* Arthaber, 1911: pl. 23(7), figs. 19a, b (Pl. 3, figs. 1–3 of this report); topotype *Columbites perrini-smithi* Arthaber, 1911: pl. 23(7), figs. 20a, b (Pl. 3, figs. 6, 7 of this report); holotype, *Columbites europaeus* Arthaber, 1908: pl. 12 (2), figs. 2a–d (Pl. 4, fig. 3 of this report); topotypes, *Columbites europaeus* Arthaber, 1911: pl. 23(7), figs. 13–18 (Pl. 1, figs. 1–9, Pl. 2, figs. 5–6 of this report); syntype, *Columbites mirditensis* Arthaber, 1911: pl. 24(8), fig. 2 (Pl. 3, figs. 8, 9 of this report); syntype, *Columbites mirditensis* Arthaber, 1911: pl. 24(8), fig. 3 (Pl. 2, figs. 7, 8 of this report); type specimen *Columbites mirditensis* var. Arthaber, 1911: pl. 24(8), fig. 4 (Pl. 3, figs. 4, 5 of this report).

The following specimens are in the Natural History Museum, Basel: plesiotype *Columbites perrini-smithi*,—Renz and Renz (1948: pl. 11, fig. 7) NHMB J13537; plesiotypes *Columbites europaeus*,—Renz and Renz (1948: pl. 11, fig. 3) NHMB J13533, (pl. 11, fig. 4) NHMB J13534, (pl. 11, fig. 5) NHMB J13535, (pl. 11, fig. 6) NHMB J13536; unfigured specimens from Maradovuno NHMB J13543, from Kephalovuno NHMB J13544; syntypes *Columbites europaeus-perrini-smithi* Renz and Renz (1948: pl. 11, fig. 1) NHMB J13538, (pl. 11, fig. 2) NHMB J13539; unfigured specimens from Maradovuno NHMB J13547, from Kephalovuno J13548; recorded specimen of *Columbites mirditensis*,—Renz and Renz (1948: 21) NHMB J13550.

The British Museum (Natural History) contains the following topotype specimens from the *Subcolumbites* fauna of Albania: *S. perrini-smithi*, C911–15, C22916–23, C22924–6; *S. europaeus*, C22890–900, C22901–10; *S. mirditensis*, C22883–6, C22887–9. Paratype from Albania MCZ 6723, from Chios MCZ 10026, specimens from Afghanistan MCZ 10138, 10146.

Subcolumbites dusmani (Arthaber)
Plate 2, figures 1–4; Text-figure 24

Columbites dusmani Arthaber, 1911: 263, pl. 24(8), figs. 1a–d; Diener, 1915: 112; Renz and Renz, 1947: 73.

Subcolumbites dusmani,—Spath, 1934: 204.

Columbites dianae Renz and Renz, 1947: 59, 73; Renz and Renz, 1948: 21, pl. 10, figs. 6–6b, 7–7b.

Columbites dianae var. *involuta* Renz and Renz, 1947: 59.

Columbites dianae var. *evoluta* Renz and Renz, 1948: 22.

Columbites graeco-americanus Renz and Renz, 1947: 59, 73; C. Renz, 1947: 176; Renz and Renz, 1948: 27, pl. 10, figs. 4–4b.

←

Figure 24. Diagrammatic representation of the sutures of species of *Subcolumbites*. A, syntype of *Columbites mirditensis* Arthaber (1911: pl. 24(8), figs. 2a–c; Pl. 3, figs. 8, 9 of this report), at a diameter of 25 mm; B, *Columbites europaeus* Arthaber (1911: pl. 23(7), figs. 15a–c; Pl. 1, figs. 1, 2 of this report), at a diameter of 35 mm; C, paratype of *Columbites dianae* Renz and Renz (1948: pl. 10, fig. 7b), at a diameter of 25 mm; D, paratype of *Fengshanites robustus* Chao (1959: 129, fig. 42a), at a diameter of approximately 30 mm; E, holotype of *Subcolumbites kwangsianus* Chao (1959: 128, fig. 41c), at a diameter of approximately 40 mm; F, *Subcolumbites multiformis* Kiparisova (1947: 144, fig. 32), at a diameter of 31 mm; G, *Subcolumbites multiformis* Kiparisova (1947: 144, fig. 31), at a diameter of approximately 15 mm; H, paratype of *Subcolumbites americanus* n. sp. (MCZ 9435, Pl. 30, fig. 8), at a diameter of 31 mm; I, paratype of *Subcolumbites americanus* n. sp. (MCZ 9438, Pl. 30 figs. 13, 14), at a diameter of 14 mm; J, syntype of *Columbites europaeus-perrini-smithi* Renz and Renz (1948: pl. 11, fig. 2b), at a diameter of approximately 40 mm.

Specimens of figures A, B from *Subcolumbites* fauna of Albania; C, J from same horizon on Chios; D, E from same horizon in Kwangsi, China; F, G from same horizon in the Primorye Region, eastern Siberia; H, I from same horizon in Tobin Formation, Nevada.

Columbites aithaliae Renz and Renz, 1947: 59, 74; Renz and Renz, 1948: 28, pl. 10, figs. 3–3b, 5–5b.
Columbites parisianus,—C. Renz, 1945: 301; C. Renz, 1947: 176; Renz and Renz, 1947: 59; Renz and Renz, 1948: 22, pl. 11, figs. 8–8b.
Columbites spencei Smith var. *chiotica* Renz and Renz, 1947: 59, 73; Renz and Renz, 1948: 22, pl. 3, figs. 7–7b.

The two syntypes of this species are relatively small specimens preserved only on one side and that only modestly well. These two specimens differ from S. *perrinismithi* in the strong reticulate ornamentation and the lack of any tendency toward carination. The reticulate ornamentation is more conspicuous on one syntype (Pl. 2, figs. 1, 2) than on the other (Pl. 2, figs. 3, 4) where it is only faintly visible.

The *Subcolumbites* fauna of Chios has yielded a number of what are believed to be conspecific forms. Renz and Renz (1948) had nine specimens of the morphological type of S. *dusmani* which they placed in five different species. Three of these species were based on one specimen each, one species was based on two specimens, and one species on four specimens. The large number of species introduced by Renz and Renz for this group reflects pronounced morphological differences from one specimen to the other. Whereas the sample comprising all these species from Chios is extremely small, a case can be made that the patterns of morphological differences are most likely gradational and that we are dealing with a single variable species. Likewise, study of large populations of other species of a similar morphological type, *Columbites parisianus* for instance, offers an insight into the potential variability that is possible in some of these Scythian ammonoids.

The holotype of *Columbites dianae* Renz and Renz is a large well preserved specimen clearly conspecific with S. *dusmani*. Renz and Renz (1948: 21) did not consider Arthaber's two syntypes of S. *dusmani* to be conspecific. On this basis they designated one of the specimens (Arthaber, 1911: pl. 24(8), figs. 1a, b; Pl. 2, figs. 3, 4 of this report) as the type (lectotype) of S. *dusmani* and considered the other specimen as conspecific with their *C. dianae* from Chios. The separation of Arthaber's two syntypes of S. *dusmani* cannot be accepted. The principal difference in these two specimens is in the expression of the reticulate ornamentation which is most pronounced on the ventral region. The specimen which Renz and Renz (1948: 21) designated as the type of S. *dusmani* is very badly weathered over most of the the venter; however, small traces of the shell are present and these clearly show a nice reticulate pattern. There is no justification for separating these two specimens into different species.

In addition to the well developed reticulate pattern on the holotype of *Columbites dianae*, there is on the adoral quarter volution a bundling of the prosiradiate ribs and a decrease in the strigations. In *Columbites aithaliae* there is a very pronounced bundling of the ribs producing strong prosiradiate folds over the ventral regions and extending half way up the flanks on the last quarter volutions. This change in ornamentational patterns takes place at an approximate diameter of 28.0 mm, whereas in *Columbites dianae* this change takes place at approximately 70 mm in diameter.

Columbites graecoamericanus Renz and Renz has the coarse bundled ribs developed on the whole adoral volution. *Columbites spencei* var. *chiotica* Renz and Renz is nothing more than a sparsely ribbed *graecoamericanus*. Each species was established on a single specimen. Finally, the *Columbites parisianus* of Renz and Renz is based on a small inner whorl of *C. dianae*. The sutures of these species are all of the same basic pattern and vary only in details (Fig. 24C).

The few specimens that are available suggest that the differences in ornament pattern are most probably a reflection of differences in ontogenetic growth, that is,

TABLE 35. MEASUREMENTS OF *SUBCOLUMBITES DUSMANI* (ARTHABER) FROM ALBANIA AND CHIOS.

	D	W	H	U	W/D	H/D	U/D
1.	74.2	25.5	31.5	21.7	34.4	42.5	29.2
2.	54.8	22.5	19.3	21.5	41.1	35.2	39.2
3.	51.3	17.8	17.7	20.7	34.7	34.5	40.4
4.	38.8	?	14.5	15.3	?	37.4	39.4
5.	37.7	?	14.5	14.9	?	38.5	39.5
6.	35.7?	?	15.3	10.4	?	59.5?	29.1?
7.	33.0	25.4	12.7	10.8	76.9	38.5	32.7
8.	26.6	14.8	15.2	10.0	55.6	57.1	37.6
9.	23.7	11.6	7.6	11.7	48.9	32.1	49.4

1. Holotype, *Columbites dianae* Renz and Renz (1948: pl. 10, fig. 6), NHMB J13540.
2. Holotype, *Columbites graeco-americanus* Renz and Renz (1948: pl. 10, figs. 4–4b), NHMB J13564.
3. Plesiotype, *Columbites spencei* var. *chiotica* Renz and Renz (1948: pl. 3, figs. 7–7b), NHMB J13553.
4. Syntype (Arthaber, 1911: pl. 24(8), figs. 1a, b), PIUV.
5. Syntype (Arthaber, 1911: pl. 24(8), figs. 1c, d), PIUV.
6. Holotype, *Columbites aithaliae* Renz and Renz (1948: pl. 10, figs. 5–5b), NHMB J13568.
7. Paratype, *Columbites aithaliae* Renz and Renz (1948: pl. 10, figs. 3–3b), NHMB J13570.
8. Paratype, *Columbites dianae* Renz and Renz (1948: pl. 10, fig. 7), NHMB J13541.
9. Plesiotype, *Columbites parisianus*,—Renz and Renz (1948: pl. 11, figs. 8–8b), NHMB J13542.

different rates of appearance of the successive stages. This type of variability in growth patterns is well illustrated in *Columbites parisianus* where we have a large population to work with and can document all of the transitional forms convincingly. It is largely on the basis of my studies of *Columbites parisianus* that I have come to the conclusion that these five species from Chios of Renz and Renz are all conspecific. Measurements of these species and of Arthaber's are given on Table 35. This interpretation, of course, needs confirmation, which can only be done when additional collections of these species are assembled.

Subcolumbites dusmani can be easily distinguished from S. *perrinismithi* in the lack of any tendency toward carination of the venter and in the general greater development of the reticulate ornamentation. *Subcolumbites robustus* Chao has a much more depressed whorl and low, broad, radial folds on the flanks, as does S. *americanus* from Nevada. *Subcolumbites multiformis* is also a species with a depressed whorl section but has no lateral nodes or folds.

Occurrence. *Subcolumbites* fauna of Albania and Chios.

Repository. Arthaber's two syntypes are in the Paleontological Institute, University of Vienna. The Chios fauna studied by Renz and Renz (1948) is in the Natural History Museum, Basel—holotype, *Columbites dianae* Renz and Renz (1948: pl. 10, fig. 6) NHMB J13540; paratype (pl. 10, fig. 7) NHMB J13541; unfigured paratypes NHMB J13551; holotype, *Columbites graecoamericanus* Renz and Renz (1948: pl. 10, fig. 4) NHMB J13564; unfigured paratypes J13565; holotype, *Columbites aithaliae* Renz and Renz (1948: pl. 10, fig. 5) NHMB J13568; paratype (pl. 10, fig. 3) NHMB J13570; unfigured paratypes from Maradovuno NHMB J13571, from Kephalovuno NHMB J13572; plesiotype, *Columbites parisianus*,—Renz and Renz (1948: pl. 11, fig. 8) NHMB J13542; unfigured specimens NHMB J13552; type specimen, *Columbites spencei* var. *chiotica* Renz and Renz (1948: pl. 3, fig. 7) NHMB J13553.

Subcolumbites robustus (Chao)
Text-figure 24

Fengshanites robustus Chao, 1950: 4, pl. 1, figs. 2, 3; Chao, 1959: 129, 305, pl. 8, figs. 1, 2, pl. 29, figs. 21–22, text-fig. 42a.

This species is of the same general morphological type as S. *americanus* from Nevada. Although the species is based on only two specimens, its distinctness is readily apparent. The whorls are more inflated and depressed than in S. *dusmani*. In addition, there are low irregular folds on the flanks. The suture is illustrated on Figure 24D.

Occurrence. 1.5 km north of Yali, Fengshan district, associated with *Dagnoceras* and *Hellenites* (Chao collection 546), Kwangsi, China.

Subcolumbites multiformis Kiparisova
Text-figure 24

Subcolumbites multiformis Kiparisova, 1947: 144, pl. 32, figs. 8–11, text-figs. 31–34; Kiparisova and Krishtofovich, 1954: 22, pl. 13, figs. 1–3; Kiparisova, 1961: 121, pl. 27, figs. 1–7, text-fig. 82–88.
Subcolumbites solitus Kiparisova, 1961: 123, pl. 26, figs. 4, 5, text-fig. 89, 90.
Subcolumbites anomalus Kiparisova, 1961: 123, pl. 26, figs. 6, 7, text-fig. 91.

Kiparisova (1961) had 35 specimens from what I judge to be the same horizon and locality at Cape Zhitkov, Primorye Region, eastern Siberia. Of these specimens, she placed 25 in S. *multiformis*, first described by her in 1947; seven specimens were placed in a second species, S. *solitus;* and three specimens were placed in another new species, S. *anomalus*. The latter two species were distinguished on the basis of slightly greater whorl depression and minor differences in the nature of the ornamentations. The suture, however, in all three species is essentially the same (Fig. 24F, G).

Unfortunately, Kiparisova supplied measurements for only 10 specimens of her three species of *Subcolumbites*; these data are tabulated on Table 36. On the basis of these data, there does not appear to be any real difference in relative whorl proportions. Kiparisova recognized that her S. *multiformis* was a highly variable form and that nearly all her specimens of *Subcolumbites* were juvenile specimens. This does not appear to be any justification for recognizing any more than one species of *Subcolumbites* within this faunal group.

Subcolumbites multiformis does not show any particularly close relationship to the group of S. *perrinismithi* or S. *dusmani*, but is very similar to S. *robustus* from Kwangsi, China, and S. *americanus* from western United States. The similarity to the latter two species is expressed in the depressed whorl section, reticulate ornamentation, and in the suture. It differs from these two species, however, in the lack of any lateral folds or nodes.

Table 36. Measurements of *Subcolumbites multiformis*, S. *solitus*, and S. *anomalus* from upper Scythian beds, Primorye Region, eastern Siberia.

	D	W	H	U	W/D	H/D	U/D
1.	45.0	24.8	15.3	18.9	55.0	34.0	42.0
2.	32.0	22.7	10.9	11.8	71.0	34.0	37.0
3.	29.0	18.9	9.9	11.3	65.0	34.0	39.0
4.	24.5	14.5	9.2	8.3	59.0	38.0	34.0
5.	17.0	11.9	5.4	6.5	70.0	32.0	38.0
6.	16.5	14.9	5.0	5.0	90.0	30.0	30.0
7.	16.0	13.4	3.5	5.9	84.0	22.0	37.0
8.	16.0	10.1	5.0	5.9	63.0	31.0	37.0
9.	11.5	10.4	3.0	4.5	90.0	26.0	39.0
10.	8.0	8.6	2.6	2.6	108.0	33.0	33.0

1–3, 5, 7, 9. *Subcolumbites multiformis*, data from Kiparisova, 1961: 121.
4, 8. *Subcolumbites solitus*, data from Kiparisova, 1961: 123.
6, 10. *Subcolumbites anomalus*, data from Kiparisova, 1961: 124.

Occurrence. *Subcolumbites* fauna at Cape Zhitkov, Primorye Region, eastern Siberia.

Subcolumbites americanus n. sp.
Plate 30, figures 1–14; Text-figure 24

This is one of the common ammonites in the Tobin Formation fauna from Nevada. The collections contain a large number of well preserved but mainly fragmentary specimens. However, ten specimens are sufficiently complete to yield measurements (Table 37).

The conch is evolute, robust, and with a characteristic pattern of ornamentation. The venter is arched and grades imperceptibly onto convex lateral areas. The umbilical shoulders are sharply rounded and the umbilical wall steep but not vertical. The conch bears low nodes situated just on the ventral side of the umbilical shoulder. In addition, there are prominent striae of growth, often bundled, which are rectiradiate on the umbilical wall and prosiradiate on the lateral areas, completely crossing the venter. There are also periodic constrictions and fine strigation.

The suture is shown on Figures 24H, I.

Clearly, this species is closely allied to S. *multiformis* from the Primorye Region and S. *robustus* from Kwangsi, China.

TABLE 37. MEASUREMENTS OF *SUBCOLUMBITES AMERICANUS* N. SP. FROM THE TOBIN FORMATION OF NEVADA.

	D	W	H	U	W/D	H/D	U/D
1.	47.3	25.0?	19.3	16.3	52.9?	40.8	34.5
2.	47.0	?	17.1	16.4	?	36.4	34.8
3.	42.2	20.8?	16.8	15.6	49.3?	39.8	36.9
4.	35.2	?	12.0	13.2	?	34.1	37.5
5.	31.8	16.1	12.6	9.7	50.6	39.6	30.5
6.	31.1	16.7	11.4	10.2	53.7	36.7	22.5?
7.	20.4	11.8?	7.3	7.0?	57.8	35.8	34.3?
8.	20.1	11.2	7.6	6.6	55.7	37.8	32.8
9.	20.1	10.3	7.8	5.7	51.2	38.8	28.4
10.	17.0	10.8	6.5	5.5	63.5	38.2	32.4

1. Holotype, MCZ 9430 (Pl. 30, figs. 1, 2).
2. Paratype, MCZ 9431 (Pl. 30, fig. 3).
3. Paratype, MCZ 9492.
4. Paratype, MCZ 9433 (Pl. 30, fig. 5).
5. Paratype, MCZ 9434 (Pl. 30, figs. 6, 7).
6. Paratype, MCZ 9435 (Pl. 30, fig. 8).
7. Paratype, MCZ 9436 (Pl. 30, figs. 9, 10).
8. Paratype, MCZ 9432 (Pl. 30, fig. 4).
9. Paratype, MCZ 9437 (Pl. 30, figs. 11, 12).
10. Paratype, MCZ 9438 (Pl. 30, figs. 13, 14).

Occurrence. Basal part of Tobin Formation, USGS locality M2562, Pershing County, Nevada; south tip of Tobin Range, Cain Mountain 1:62,500 quad., center NW ¼ sec. 9, T. 26N, R. 39E, 5,500 ft. S, 27.5 ft. W of elevation point 5088 on range crest.

Repository. Holotype (Pl. 30, figs. 1, 2) MCZ 9430; figured paratypes (Pl. 30, fig. 3) MCZ 9431, (Pl. 30, fig. 4) MCZ 9432, (Pl. 30, fig. 5) MCZ 9433, (Pl. 30, figs. 6, 7) MCZ 9434, (Pl. 30, fig. 8) MCZ 9435, (Pl. 30, figs. 9, 10) MCZ 9436, (Pl. 30, figs. 11, 12) MCZ 9437, (Pl. 30, figs. 13, 14) MCZ 9438; unfigured paratypes MCZ 9492.

Genus *Paradinarites* Chao, 1950
Type species, *Paradinarites suni* Chao, 1950
Paradinarites suni Chao
Text-figure 21

Paradinarites suni Chao, 1950: 6, pl. 1, figs, 7a, b, text-fig. 4; Chao, 1959: 98, 330, pl. 41, figs. 9–12.

Chao (1959: 331) recognized that this new genus and species was quite similar to "*Columbites*" in conch form and gross aspect of the suture but considered the goniatitic character of the lobes to indicate affinity with the dinaritids. The general shape of the conch is that of a *Subcolumbites* but lacks strigations. The suture (Fig. 21C), also, with its large first lateral lobe is columbitid in plan and, in fact, quite like the suture of *Procolumbites karataucikus* Astakhova (1960a, b) from the upper Scythian Formation of the Mangyshlak Peninsula. The species is known from only two not very well preserved specimens but on the basis of the data available it clearly appears to be a columbitid.

Occurrence. Subcolumbites fauna (Chao collection 610), Kwangsi, China.

Genus *Pseudoceltites* Hyatt, 1900
Type species, *Celtites multiplicatus* Waagen, 1895

Evolute, ribbed ammonites of rather simple design are very common in mid-Scythian formations. This has led to a proliferation of specific and generic names, the relationships of which are seldom understood or appreciated. The type specimen of *Celtites multiplicatus* is a poorly preserved specimen from the Upper Ceratite Limestone of the Salt Range (Pl. 27, figs. 5, 6). *Celtites armatus* Waagen (1895: 75, pl. 7, figs. 1, 7), the type species of *Kashmirites* Diener (1913) is clearly a synonym of *Celtites multiplicatus* Waagen (Pl. 27, figs. 7–10). Spath (1930: 35) introduced the name *Anakashmirites* (type species *Danubites nivalis* Diener, 1897: 51, pl. 15, figs. 17–19) for ammonoids not too different in appearance from *Celtites multiplicatus.* Examination of the Salt Range, Himalayan, and Timor specimens that have been assigned to one or more of these three genera by Waagen (1895), Diener (1897, 1909, 1913), Welter (1922), and Spath (1930, 1934) show that the ornamentational pattern is highly variable. It is in the suture pattern that one can readily separate *Pseudoceltites* and *Anakashmirites.* The former genus has a very reduced second lateral lobe that rests on or near the umbilical shoulder, whereas in

Anakashmirites there is a "normal" second lateral lobe and generally an auxiliary lobe at or near the umbilical shoulder.

As mentioned above, the type species is from the Upper Ceratite Limestone of the Salt Range, West Pakistan. In the upper part of the Scythian, three species are recognized: one (*cheneyi*) from the *Columbites* fauna of southeastern Idaho, the second (*nevadi*) from the Upper Thaynes Formation, western Utah, and the third (*dolnapaensis*) from the upper Scythian formation of the Mangyshlak Peninsula.

This genus is grouped here with the columbitids on the basis of the gross aspect of the conch and especially the basic pattern of the suture. In these aspects this genus shows similarities to such columbitids as *Columbites* and *Procolumbites*.

Pseudoceltites cheneyi n. sp.
Plate 44, figures 4–10; Text-figure 25

A number of exposures of the *Columbites* fauna of the Thaynes Formation in southeastern Idaho have yielded approximately 50 generally well-preserved specimens of this distinctive species. The conch is evolute and compressed. Measurements on 15 well-preserved specimens from one horizon and locality are given on Table 38. As can be readily seen, there is very little variation in relative thickness and height of the whorls or in umbilical diameter. The lateral areas of the whorls are flattened and slightly convergent; the venter is broad and arched. The ventral shoulder is broadly rounded, and the umbilical shoulder is more abruptly rounded with a short, steep umbilical wall. The umbilicus is broad and shallow.

Table 38. Measurements of *Pseudoceltites cheneyi* n. sp. from the *Columbites* fauna of Draney Creek, southeastern Idaho. The width dimension includes the lateral ribs.

	D	W	H	U	W/D	H/D	U/D
1.	29.2	8.4	9.6	12.0	28.8	32.9	41.1
2.	29.0	?	10.0	12.1	?	47.8	57.9
3.	27.8	8.6	9.8	12.1	30.9	35.3	43.5
4.	27.5	7.6?	10.0	10.0	27.6?	36.4	36.4
5.	26.5	7.8	7.6	11.6	29.4	28.7	43.8
6.	26.0	8.0	9.6	9.2	30.8	36.9	35.4
7.	25.7	7.8	9.4	9.1	30.4	36.6	35.4
8.	22.7	7.4	7.8	9.0	32.6	34.4	39.6
9.	21.7	7.3	7.5	9.6	33.6	34.6	44.2
10.	21.4	7.0	6.9	8.3	32.7	32.2	38.8
11.	20.1	7.4	6.9	8.5	36.8	34.3	42.3
12.	20.1	7.5	6.5	9.2	37.3	32.3	45.8
13.	16.6	6.5	5.7	6.8	39.2	34.3	40.9
14.	14.0	6.4	4.5	5.3	45.7	32.1	37.9
15.	13.0	5.1	4.6	4.9	39.2	35.4	37.7

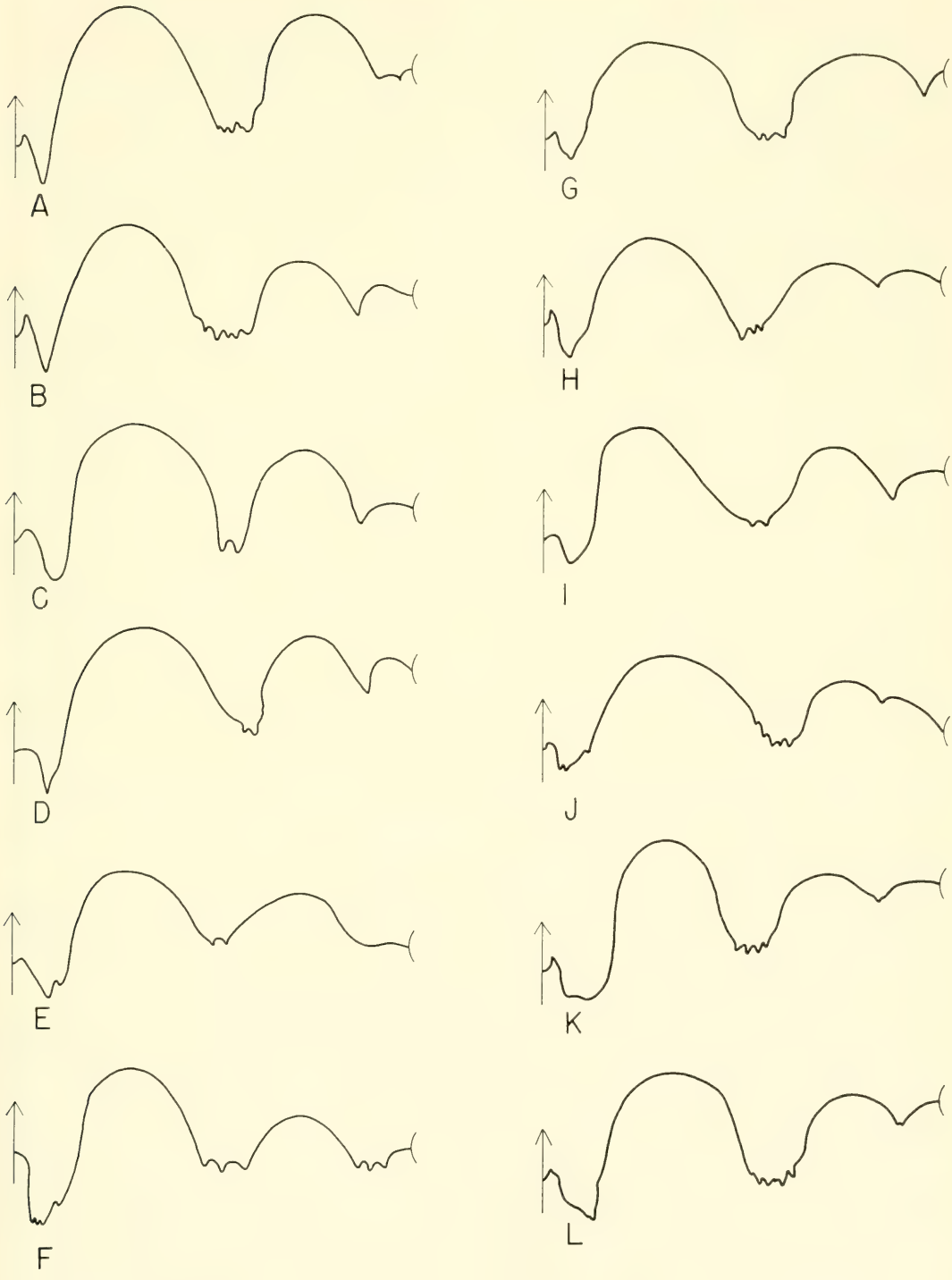
The lateral areas bear straight prosiradiate ribs that expand slightly toward the ventral shoulder where they project slightly forward. The ribs do not extend on to the venter, which is smooth except for growth lines and occasional constrictions which join the interrib areas from the opposite flanks. There are approximately 20 such ribs on the outer volution. There is some variation in the spacing of the ribs and in the relative strength or prominence of the ribs, but this variation is very slight and appears to be of no significance.

The suture consists of two rounded lateral saddles, a prominent first lateral lobe, with some denticulations, and a small, generally pointed second lateral lobe on the umbilical shoulder. The variation in the shape and proportions of the sutural elements is quite spectacular (Fig. 25).

→

Figure 25. Diagrammatic representation of the sutures of *Pseudoceltites cheneyi* n. sp. A, at a diameter of 13 mm (MCZ 9507); B, at a diameter of 17 mm (MCZ 9508); C, at a diameter of 20 mm (USNM 153074); D, at a diameter of 17 mm (MCZ 9503, Pl. 44, fig. 4); E, at a diameter of 20 mm (USNM 153075); F, at a diameter of 17 mm (USNM 153076); G, at a diameter of 16 mm (WSU); H, at a diameter of 15 mm (MCZ 9509); I, at a diameter of 14 mm (MCZ 9506); J, at a diameter of 17 mm (USNM 153077); K, at a diameter of 20 mm (USNM 153073, Pl. 44, figs. 8, 9), holotype; L, at a diameter of 17 mm (MCZ 9574).

All specimens from *Columbites* fauna, Thaynes Formation, southeastern Idaho; specimens A, B, D, H, I, J, and L are from Hot Springs; C, E, F, G, and K from Draney Creek.


A
B
C
D
E
F
G
H
I
J
K
L

The variation as illustrated by these 12 sutures should be sobering to those who tend to erect species on minor differences in the suture.

The type specimen of *Celtites multiplicatus* Waagen is a weathered specimen, in which only the outer volution is present; the inner whorls are completely weathered out (Pl. 27, figs. 5, 6). Waagen's illustration (1895: pl. 7, fig. 2) is highly restored and actually misleading. Even though the preservation of the Salt Range specimen leaves much to be desired, it is morphologically very similar to *Pseudoceltites cheneyi*. The Idaho species differs in its prosiradiate ribs rather than the radial ribs of *P. multiplicatus*. Waagen mentions slight nodes on the umbilical and ventral shoulders associated with the ribs; these nodes, however, are not present on the type specimen. The basic pattern of the suture of these two species is the same (Fig. 25). *Celtites multiplicatus* came from the Upper Ceratite Limestone of the Salt Range, which is mid-Scythian in age. The present species is from the *Columbites* Zone.

Occurrence. Middle shale member of Thaynes Formation, *Columbites* fauna, along Draney Creek, Stewart Flat, Quadrangle (USGS locality M98); and in Montpelier Canyon, Hot Springs, and Paris Canyon, all in the Bear Lake region of southeastern Idaho.

Repository. Holotype USNM 153073 (Pl. 44, figs. 8, 9); figured paratypes, MCZ 9503 (Pl. 44, fig. 4), MCZ 9504 (Pl. 44, fig. 5), MCZ 9505 (Pl. 44, figs. 6, 7), MCZ 9506 (Pl. 44, fig. 10); suture specimens MCZ 9507 (Fig. 25A), MCZ 9508 (Fig. 25B), USNM 153074 (Fig. 25C), MCZ 9503 (Fig. 25D), USNM 153075 (Fig. 25E), USNM 153076 (Fig. 25F), Department of Geology, Washington State University (Fig. 25G), MCZ 9509 (Fig. 25H), MCZ 9506 (Fig. 25I), USNM 153077 (Fig. 25J), USNM 153073 (Fig. 25K), MCZ 9574 (Fig. 25L); unfigured specimens from Hot Springs, southeast Idaho MCZ 9510; unfigured specimens from Montpelier Canyon, southeast Idaho MCZ 9511.

Pseudoceltites dolnapaensis Kiparisova
Text-figure 21

Columbites dolnapaensis Kiparisova, 1947: 143, pl. 30, fig. 3, text-fig. 30.
Columbites constrictilis Astakhova, 1960a: 140, pl. 33, fig. 6, text-fig. 8.

This species is remarkably similar to *Pseudoceltites cheneyi* n. sp. from the *Columbites* fauna of southeastern Idaho in its conch shape, ornament, and suture. The differences are primarily centered on the pattern of forward projecting constrictions on the adoral part of the conch. This species cannot be assigned to *Columbites* as the patterns of ribs and constrictions are very different. Astakhova (1960a) distinguished her species *constrictilis* from *Columbites dolnapaensis* Kiparisova partly on the basis that *constrictilis* had two denticulations on the first lateral lobe, and *dolnapaensis* had three. Examination of Figure 25, with 12 sutures of *P. cheneyi*, will give some indication of the variations possible within the basic pattern of the suture.

Occurrence. Mangyshlak Peninsula, *Columbites* Zone of Astakhova (1960a), associated with *Albanites*, *Epiceltites* and *Olenekites*.

Pseudoceltites nevadi n. sp.
Plate 34, figures 1–5; Text-figure 21

Xenoceltites cf. *X. spitsbergensis*.—Silberling, *in* Hose and Repenning, 1959: 2189, 2194.

The collections contain a large number of fragmentary, poorly preserved specimens. The basic form of the conch, whorl cross-section, pattern of ribs, and suture is very much like that of *Pseudoceltites cheneyi* from the *Columbites* fauna of southeastern Idaho. The suture (Figs. 21 and 25) likewise is very similar. It is possible that these two species are conspecific, but *nevadi* attains a much greater size than *cheneyi*, and on this basis it is thought best to keep the forms separate.

One fragment must be from a specimen of a diameter of approximately 65 mm.

Occurrence. USGS fauna M111, from upper part of Thaynes Formation, in section 15 of Hose and Repenning (1959: 2187), Confusion Range, western Utah.

Repository. Holotype USNM 153078 (Pl. 34, fig. 1); paratypes USNM 153079 (Pl. 34, figs. 2, 3), USNM 153080 (Pl. 34, figs. 4, 5).

Genus *Procolumbites* Astakhova, 1960
Type species, *Procolumbites karataucikus* Astakhova, 1960

Procolumbites karataucikus Astakhova
Text-figure 26

Procolumbites karataucikus Astakhova, 1960a: 142, pl. 34, figs. 1a–c, text-fig. 9 (*nomen nudum* Bajarunas, 1936: 547).

A columbitid with low ventral keel on phragmocone, venter on body chamber rounded. Ornamented with radial ribs and constrictions that cross the venter. Suture (Fig. 26G) with single, pointed, lateral lobe.

Occurrence. This genus and species is only known from the upper Scythian formation of the Mangyshlak Peninsula in beds associated with *Pseudoceltites dolnapaensis*, *Olenekites mangyshlakensis*, and *Albanites triadicus*.

Genus *Prenkites* Arthaber, 1911
Type species, *Prenkites malsorensis* Arthaber, 1911

There are only three species of this genus. One of these (*timorensis*) is known from Chios, Timor, and China. The type species is represented in the *Subcolumbites* fauna of Albania and Chios, whereas the third species (*helenae*) is only known from the Chios fauna.

Prenkites malsorensis Arthaber
Plate 7, figures 7–10; Text-figure 26

Prenkites malsorensis Arthaber, 1911: 258, pl. 22(6), figs. 17–19; Diener, 1915: 226; C. Renz, 1931: 344; Spath, 1934: 208, pl. 12, figs. 7a–c, text-figs. 111f–h; Renz and Renz, 1947: 59; Renz and Renz, 1948: 29, pl. 12, figs. 11–11a, 12.

Arthaber (1911: 258) stated he had 29 specimens of this species, but of these only 6 are still preserved in the Paleontological Institute, Vienna. In contrast to this fair representation, the *Subcolumbites* fauna of Chios has yielded only two specimens. The general character of the conch and the suture (Fig. 26A, B) is quite similar to that of *P. timorensis* which is distinguished on the basis of its ornamentation. *Prenkites helenae* Renz and Renz (1948) is a more broadly evolute form with rounded umbilical shoulders and lacking the small nodes on the umbilical shoulder.

Occurrence. Subcolumbites fauna of Albania and Chios.

Repository. Six specimens, including the two figured by Arthaber (1911: pl. 22(6), figs. 17, 19; Pl. 7, figs. 7–10 of this report) are in the Paleontological Institute, Vienna. The two plesiotypes from Chios, NHMB J13574, J13575.

Prenkites helenae Renz and Renz
Text-figure 26

Prenkites helenae Renz and Renz, 1947: 60, 74; Renz and Renz, 1948: 30, pl. 12, figs. 2–2a, 5–5a.

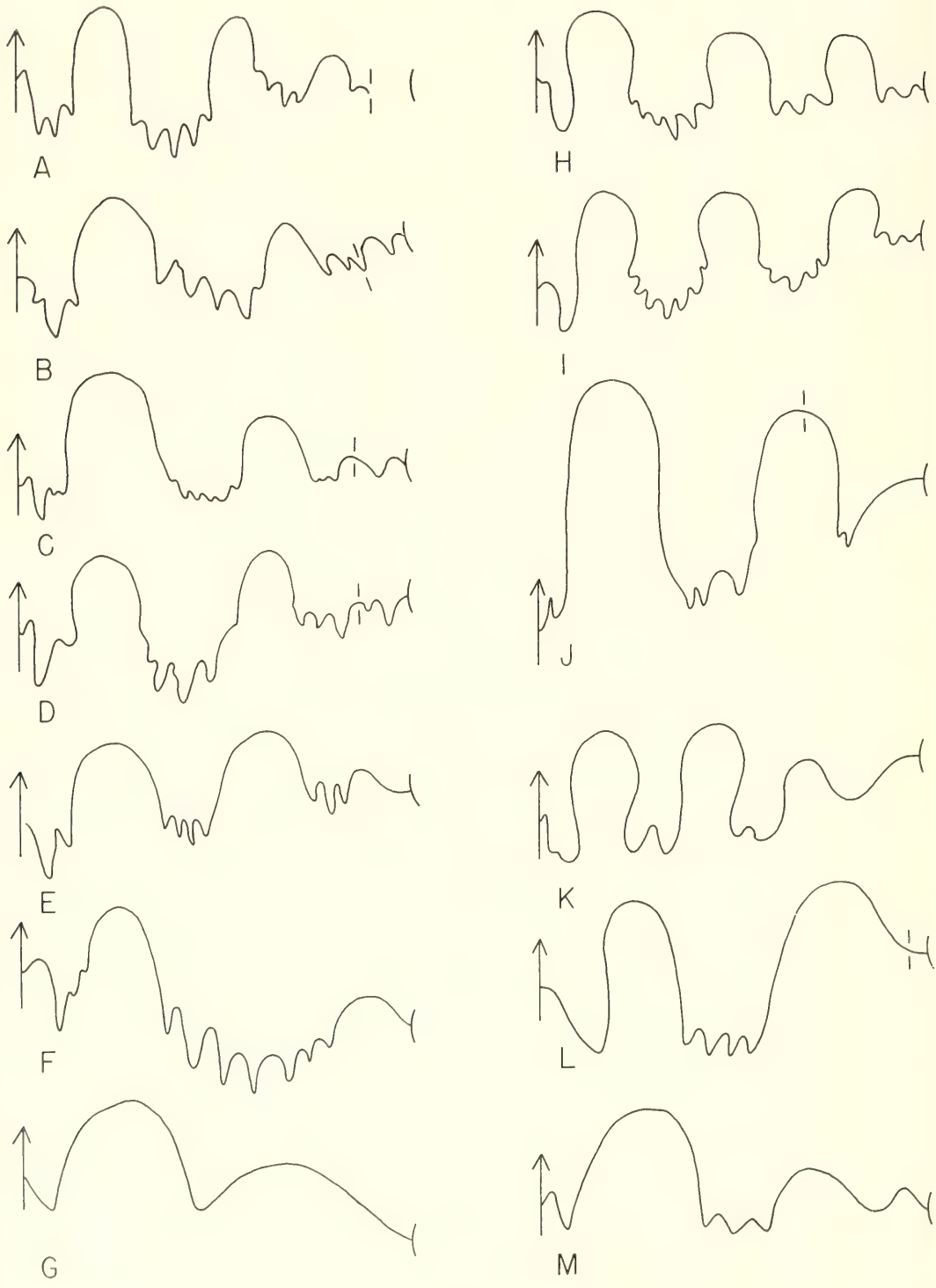
This species is an evolute *malsorensis* with rounded umbilical shoulders that lack the small nodes. The species is based on only two specimens; the measurements of the holotype are Diameter 49.3 mm, Width 18.5 mm, Height 18.3, Umbilicus 17.5, the same for the paratype are Diameter 35.8, Width 17.8, Height 12.1, Umbilicus 14.6. The suture is shown on Figure 26C.

Occurrence. Subcolumbites fauna, Chios.

Repository. Holotype NHMB J13577; paratype NHMB J13578; unfigured paratypes from Maradovuno J13579, 13580.

Prenkites timorensis Spath
Text-figures 17, 26

Columbites nov. sp. indet. Welter, 1922: 150, pl. 168(14), figs. 12, 13.


A
B
C
D
E
F
G
H
I
J
K
L
M

Prenkites timorensis Spath, 1930: 77; Spath, 1934: 208, fig. 62d, e.

Columbites malayanus C. Renz, 1945: 301; C. Renz, 1947: 176; Renz and Renz, 1947: 59, 73; Renz and Renz, 1948: 24, pl. 9, figs. 5, 6–6c, 8–8b, 9–9d, 10.

Columbites malayanus var. *crassa* Renz and Renz, 1947: 59, 73; Renz and Renz, 1948: 26, pl. 9, figs. 4–4b.

Columbites bubulinae Renz and Renz, 1947: 59, 73; Renz and Renz, 1948: 26, pl. 9, figs. 7–7a, pl. 10, figs. 1–1b.

Columbites levantinus Renz and Renz, 1947: 59, 74; Renz and Renz, 1948: 27, pl. 10, figs. 2–2b.

Columbites hellenicus Renz and Renz, 1947: 59, 74; Renz and Renz, 1948: 28, pl. 11, figs. 9–9c.

Columbites ex aff. *plicatuli* Smith,—Renz and Renz, 1948: 23.

Prenkites kwangsianus Chao, 1959: 130, 307, pl. 29, figs. 15–20, text-fig. 42b.

Columbites huangi Chao, 1959: 126, 301, pl. 29, figs. 6–11, text-fig. 41a.

Columbites costatus Chao, 1959: 126, 302, pl. 29, figs. 1–3, text-fig. 41b.

Columbites yaliensis Chao, 1959: 126, 302, pl. 29, figs. 12–14.

TABLE 39. MEASUREMENTS OF *PRENKITES TIMORENSIS* SPATH.

	D	W	H	U	W/D	H/D	U/D
1.	45.2	22.8	23.0	15.5	50.4	50.9	34.3
2.	45.2	?	17.4	16.0	?	38.5	35.4
3.	42.0±	24.4	15.6	15.7	58.1±	37.1±	47.4±
4.	38.5	22.7	15.3	13.5	59.0	39.7	35.1
5.	36.5	21.7?	14.4	12.3	59.5?	39.5	33.7
6.	34.8?	24.7?	13.0	14.7	71.0?	37.4?	42.2?
7.	32.0	15.1	13.2	10.0	47.2	41.3	31.3
8.	29.1	20.5	12.8	8.2	70.4	44.0	28.2

1. Holotype, *Columbites bubulinae* Renz and Renz (1948: pl. 10, fig. 1), NHMB J13561.
2. Paratype, *Columbites bubulinae* Renz and Renz (1948: pl. 9, fig. 7), NHMB J13562.
3. Paratype, *Columbites malayanus*,—Renz and Renz (1948: pl. 9, fig. 9), J13558.
4. Holotype, *Columbites malayanus*,—Renz and Renz (1948: pl. 9, fig. 6), J13555.
5. Paratype, *Columbites malayanus*,—Renz and Renz (1948: pl. 9, fig. 8), J13557.
6. Type specimen, *Columbites malayanus* var. *crassa* Renz and Renz (1948: pl. 9, fig. 4), J13549.
7. Holotype, *Columbites hellenicus* Renz and Renz (1948: pl. 11, fig. 9), J13573.
8. Paratype, *Columbites malayanus*,—Renz and Renz (1948: pl. 9, fig. 5), J13556.

This is the "ornamented" species of *Prenkites*. It has a conch essentially like that of *P. malsorensis* except for constrictions and associated ribs which extend over the flanks and project adorally as they cross the venter. Welter (1922) had only one specimen of this species and this is the type; a second specimen is in the British Museum (Natural History). The *Subcolumbites* fauna from Chios has yielded eight specimens which I believe are conspecific with the Timor form originally described by Welter (1922). Their measurements are given on Table 39. Renz and Renz (1948: 24) were not familiar with Spath's publications (1930, 1934) in which he introduced the name *Prenkites timorensis* for *Columbites* sp. indet. Welter (1922: 150, pl. 168(14), figs. 12, 13). *Columbites malayanus* Renz and Renz was introduced for a series of Chios forms that were believed to be conspecific with the Timor *Columbites* sp. indet. of Welter. A second species, *Columbites bubulinae* Renz and

←

Figure 26. Diagrammatic representation of the suture of: A, *Prenkites malsorensis* Arthaber (1911: pl. 22(6), fig. 17c), at a diameter of 20 mm; B, *Prenkites malsorensis*,—Renz and Renz (1948: pl. 12, fig. 12), at a diameter of approximately 15 mm; C, *Prenkites helenae* Renz and Renz (1948: pl. 12, fig. 5b), at a diameter of approximately 25 mm; D, *Prenkites timorensis*,—Renz and Renz (1948: pl. 9, fig. 9d), at a diameter of approximately 27 mm; E, *Prenkites timorensis*,—Chao (1959: fig. 42b), at a diameter of approximately 20 mm; F, *Protropites hilmi* Arthaber (1911: pl. 22(6), fig. 16), at an unknown diameter; G, *Procolumbites karataucikus* Astakhova (1960a: fig. 9), at a diameter of approximately 20 mm; H, *Chioceras mitzopouloi* Renz and Renz (1948: pl. 12, fig. 13), at a diameter of approximately 30 mm; I, *Chioceras nodosum* Renz and Renz (1948: pl. 12, fig. 7c), at a diameter of approximately 20 mm; J, *Arianites musacchi* Arthaber, new suture from holotype (Pl. 2, figs. 9, 10), at a diameter of 20 mm; K, *Meropella plejanae* Renz and Renz (1948, pl. 3, fig. 4b); L, *Epiceltites gentii* Arthaber (1911: pl. 24(8), fig. 8d), at a diameter of 20 mm; M, *Epiceltites subgracilis* (Astakhova, 1960a: fig. 132), at a diameter of approximately 15 mm.

Specimens of figures A, F, J, L from *Subcolumbites* fauna of Albania; specimens of figures B, C, D, H, I, K from *Subcolumbites* fauna of Chios; specimen of figure E from *Subcolumbites* fauna of Kwangsi, China; G, M from upper Scythian horizon on the Mangyshlak Peninsula.

Renz was introduced for slightly more compressed forms. A third species, *Columbites hellenicus* Renz and Renz is a slightly aberrant form, compressed, with more rounded umbilical shoulders and with a more subdued pattern of ornamentation. This species is based on a single specimen and is considered here as falling within the pattern of variation of *P. timorensis.*

Columbites ex aff. *plicatuli,* Renz and Renz (1948: 23) is based on two fragmentary specimens that have nothing in common with *Columbites plicatulus* Smith (1914: 37). They are actually more like the forms Renz and Renz assigned to *Columbites bubulinae.*

Prenkites kwangsianus Chao (1959) was established on three specimens from *Subcolumbites* horizons in Kwangsi, China. The descriptions and illustrations of this species leave much to be desired. In spite of this, I believe this species to be conspecific with the forms from Timor and Chios assigned to *P. timorensis.* The insight one can get on the variation within this species from a study of the Chios fauna lends support to the conclusion that the differences in the ribbing used by Chao to distinguish his species are not of specific importance. The Kwangsi species of *Columbites—huangi, costatus,* and *yaliensis* —described by Chao (1959) occur together at least in some outcrops and with *Prenkites kwangsianus* at the Yali section. These three species are clearly conspecific; they differ only in the degree of ribbing. These three forms are remarkably similar to *Columbites levantinus* Renz and Renz (1948: pl. 10, fig. 2) from the *Subcolumbites* fauna of Chios. Analysis of the whole Chios fauna suggests that *Prenkites timorensis* is a highly variable species that can and should include *Columbites levantinus.* These Kwangsi species (*C. huangi, costatus,* and *yaliensis*) are here considered to be a variant similar to *C. levantinus* which belongs within the scope of *P. timorensis.*

The suture of *Columbites huangi* Chao is shown on Figure 17C; *Prenkites timorensis* Spath is illustrated on Figures 26D, E.

Occurrence. Subcolumbites fauna of Chios; from block E, Nifoekoko, Timor; from *Subcolumbites* fauna in the Linglo and Fengshan districts of Kwangsi, China (Chao collections 542a, 546, 610); *Prenkites* aff. *timorensis* is present in the *Subcolumbites* fauna of the Primorye Region.

Repository. Holotype, Paleontological Institute, Bonn; topotype BMNH C33714; holotype, *Columbites malayanus* Renz and Renz (1948: pl. 9, fig. 6) NHMB J13555; paratypes (pl. 9, fig. 9) NHMB J13558, (pl. 9, fig. 8) NHMB J13557, (pl. 9, fig. 5) NHMB J13556; var. *crassa* (pl. 9, fig. 4) NHMB J13549, (pl. 9, fig. 10) NHMB J13559; unfigured paratypes NHMB J13546; holotype *Columbites bubulinae* Renz and Renz (1948: pl. 10, fig. 1) NHMB J13561; paratype (pl. 9, fig. 7) NHMB J13562; unfigured paratypes from Maradovuno NHMB J13563, from Kephalovuno NHMB J13569; holotype *Columbites hellenicus* Renz and Renz (1948: pl. 11, fig. 9) NHMB J13573.

Genus *Protropites* Arthaber, 1911
Type species, *Protropites hilmi* Arthaber, 1911 (lectotype selected by Spath, 1934)

Involute, inflated forms with cadicone inner whorls and carinate outer whorls. With strongly prosiradiate growth lines, occasionally enlarged on crossing the keel. Suture with single wide lateral lobe.

The type species is the only one known for this genus and has been recognized only in the *Subcolumbites* fauna of Kčira, Albania. Spath (1934: 206) considered *Protropites* to be an extreme development of *Subcolumbites mirditensis.* In this conclusion I concur. The rather poor preservation of the available material does not permit analysis of the ontogeny of the only known species; however, in its gross morphological features and the suture it does appear to be a columbitid though its exact relationships remain uncertain.

Protropites hilmi Arthaber
Plate 14, figures 1–8; Text-figure 26

Protropites hilmi Arthaber, 1911: 256, pl. 22(6), figs. 9–16; Diener, 1915: 235; Renz, 1928: 155; Spath, 1934: 206, pl. 13, figs. 4a–c.

Arthaber's illustrations of the *Subcolumbites* fauna of Albania are retouched photographs which on the whole are successful. Arthaber illustrated six specimens plus a suture (Fig. 26F) from an unspecified specimen. Two of these specimens plus the specimen which yielded the suture are missing in the collection and presumed lost. These are the specimens of figures 10, 11, and 16 of plate 22(6) in Arthaber (1911). The collections of the Paleontological Institute at the University of Vienna contain approximately 20 specimens of the species with no label as to origin, collector, etc. It is presumed that these are part of the original collection from Kčira, studied by Arthaber. Unfortunately, the preservation of these specimens is uniformly bad, none yielded any sutures, and none could yield any useful measurements.

None of the four surviving primary types studied by Arthaber are particularly well preserved. The measurements of these specimens are as follows:

	D	W	H	U	W/D	H/D	U/D
1.	33.2	?	12.1	12.6	?	36.4	38.0
2.	32.2	10.5?	11.9	12.8	32.6?	37.0	39.8
3.	29.2	10.2	11.4	10.8	34.9	39.0	37.0
4.	25.5	11.2	10.5	10.6	43.9	41.2	41.6

1. Lectotype, Arthaber (1911: pl. 22(6), fig. 15a, b).
2. Paralectotype, Arthaber (1911: pl. 22(6), fig. 13a, b).
3. Paralectotype, Arthaber (1911: pl. 22(6), fig. 12a, b).
4. Paralectotype, Arthaber (1911: pl. 22(6), fig. 14a, b).

The lectotype (Pl. 14, figs. 3, 4) was selected by Spath (1934: 206). Only the venter and one side of the specimen are preserved. The keel is very well developed and present on the whole adoral volution. Because of poor preservation, surface features of the shell are obscure. Faint patches of growth lines are present and on the most adoral part of the last volution there are two broad radial folds. The umbilical shoulder of the inner volutions appears to bear small nodes, but these are obscured by the poor preservation.

The largest of Arthaber's figured paralectotypes (Pl. 14, figs. 1, 2) is a more compressed form with less inflated whorls. Likewise only one side and the venter of the specimen is preserved. The next paralectotype (Pl. 14, figs. 5, 6) is of the same preservation and is an even more compressed form. The inner whorls are not as depressed and cadicone as in the lectotype. The growth lines are in places well preserved and show the strong forward projection on the keel. Some of the growth lines on crossing the keel are enlarged. The specimen figured by Spath (1934: pl. 8, fig. 4a) is comparable to this compressed form. The fourth specimen (Pl. 14, figs. 7, 8) is the most inflated, with strongly depressed cadicone inner whorls. It shows the gradual contraction of the body chamber very well. The conch is smooth except for very faint and indistinct growth lines.

Occurrence. *Subcolumbites* fauna, Kčira, Albania.

Repository. Lectotype, three figured paralectotypes, and approximately 20 topotype specimens are in the Paleontological Institute, University of Vienna. There are eight topotype specimens in the British Museum (Natural History) (C22838–45).

Genus *Chioceras* Renz and Renz, 1947
Type species, *Chioceras mitzopouloi* Renz and Renz, 1947

Smooth, evolute conchs, inner whorls rounded, slightly depressed, showing progressive expansion; outer whorls with conspicuous, smooth rounded keel; body chamber slightly more than one volution in length; suture with two denticulated lateral lobes, third lobe on umbilical shoulder, saddles rounded. One species bears large lateral nodes.

This genus is known only from two

species from the *Subcolumbites* fauna of Chios. It is, however, fairly well represented in numbers of individuals in the Chios fauna, as preserved in the Natural History Museum in Basel.

The rounded keel immediately reminds one of *Protropites* and at first these forms were thought to belong to that genus. However, the cadicone inner whorls of *Protropites* and the completely different suture preclude any genetic relationship. It is interesting to note that whereas *Protropites hilmi* is fairly well represented in the *Subcolumbites* fauna of Albania, it is not present in the fauna from Chios.

The character of the suture appears to be the best indication of genetic relations and this suggests *Prosphingites*. The conch can be looked upon as an evolute form of *Prosphingites* with the marked addition of the rounded keel.

Chioceras mitzopouloi Renz and Renz
Text-figure 26

Chioceras mitzopouloi Renz and Renz, 1947: 60, 74; Renz and Renz 1948: 37, pl. 12, figs. 3–3b, 6–6a (holotype), 9–9a, 13; Kummel, *in* Arkell et al., 1957: L140, figs. 172, 10a–c.

Chioceras mitzopouloi var. *meridionalis* Renz and Renz, 1947: 10; Renz and Renz, 1948: 38, pl. 12, figs. 8–8b.

This is the smooth species of *Chioceras*. The measurements of the holotype and figured paratypes are as follows:

	D	W	H	U	W/D	H/D	U/D
1.	49.0	?	16.6	19.7	?	33.9	40.2
2.	44.3	14.8	15.9	16.7	33.4	35.9	37.7
3.	43.5	13.7	13.1	18.4	31.5	30.1	42.3
4.	33.9	13.8	10.5	15.5	40.7	31.0	45.7
5.	30.6	10.8	10.7	13.0	35.3	35.0	42.5

1. Holotype, Renz and Renz (1948: pl. 12, fig. 6) NHMB J13626.
2. Paratype, Renz and Renz (1948: pl. 12, fig. 13) NHMB J13627.
3. var. *meridionalis* Renz and Renz (1948: pl. 12, fig. 8) NHMB J13632.
4. Paratype, Renz and Renz (1948: pl. 12, fig. 9) NHMB J13628.
5. Paratype, Renz and Renz (1948: pl. 12, fig. 3) NHMB J13629.

There are numerous unfigured paratypes in the Chios collection in Basel that are too poorly preserved or prepared to yield useful measurements. The suture is shown on Figure 26H.

Occurrence. Subcolumbites fauna, Maradovuno, Kephalovuno, and Marmarotrapeza, Chios.

Repository. The figured specimens are listed in the table of measurements; in addition there are unfigured paratypes from Maradovuno NHMB J13630, and from Kephalovuno NHMB J13631.

Chioceras nodosum Renz and Renz
Text-figure 26

Chioceras nodosum Renz and Renz, 1947: 60, 74; Renz and Renz, 1948: 38, pl. 12, figs. 7–7c.

This species was established for a single species that is like *C. mitzopouloi* except for the presence of large, rounded nodes on the lateral areas. The measurements of the holotype are:

D	W	H	U	W/D	H D	U/D
30.5	12.1	10.7	12.5	39.7	35.1	41.0

The suture is illustrated on Figure 26I.

Occurrence. Subcolumbites fauna, Maradovuno, Chios.

Repository. Holotype NHMB J13633; unfigured paratype NHMB J13634.

Genus *Arianites* Arthaber, 1911
Type species, *Arianites musacchi* Arthaber, 1911

This genus and species are based on a single poorly preserved specimen from the *Subcolumbites* fauna of Albania. I agree with Spath (1934: 209) that it is most probably a columbitid.

Arianites musacchi Arthaber
Plate 2, figures 9, 10; Text-figure 26

Arianites musacchi Arthaber, 1911: 264, pl. 24(8), fig. 5; Diener, 1915: 53; Spath, 1934: 209; Kummel, *in* Arkell et al., 1957: L140, fig. 172, 14.

The type, and only specimen, of this species is incomplete and generally poorly preserved. The last half volution is body

chamber; the inner whorls are for the most part buried in matrix. The outer volution is completely smooth except for vague traces of growth lines. A small portion of the penultimate volution is visible, and this shows sharp radial ribs on the flanks and umbilical shoulder. A new drawing of the suture is reproduced here on Figure 26J. Arthaber's drawing of the suture is inaccurate, especially in his treatment of the first lateral lobe.

Occurrence. *Subcolumbites* fauna, Kčira, Albania.

Repository. Paleontological Institute, Vienna.

Genus *Meropella* Renz and Renz, 1947
Type species, *Arianites (Meropella) plejanae* Renz and Renz, 1947

Evolute conchs with rounded whorl section of approximately equal width and height dimensions. Ventral and umbilical shoulders rounded. Early volutions bear slight umbilical nodes.

The suture consists of two bifid lateral lobes and a smooth, small auxiliary lobe on the umbilical shoulder.

This genus and species is known only from the *Subcolumbites* fauna of Chios. A fragmentary specimen from the *Subcolumbites* fauna of Kotal-e-Tera, Afganistan, has been described by Kummel (1968b) as *Meropella* cf. *plejanae*.

Meropella plejanae Renz and Renz
Plate 20, figures 14, 15; Text-figure 26

Arianites (*Meropella*) *plejanae* Renz and Renz, 1947: 67, 79; Renz and Renz, 1948: 95, pl. 3, figs. 3–3b, 11–11b.

Meropella plejanae,—Kummel, *in* Arkell et al., 1957: L140, fig. 172, 12.

There are only four specimens of this species known. The measurements of these are:

	D	W	H	U	W/D	H/D	U/D
1.	22.5	5.7	5.8	11.8	25.3	25.8	52.4
2.	20.0	4.6	5.7	9.8	23.0	28.5	49.0
3.	14.6	4.0	4.0	7.3	27.5	27.5	50.0
4.	12.5	3.2	3.6	5.6	25.6	28.8	44.8

1. Figured paratype, Renz and Renz (1948: pl. 3, fig. 11) NHMB J13826.
2. Holotype, Renz and Renz (1948: pl. 3, fig. 4) NHMB J13825.

3, 4. Unfigured paratypes, NHMB J13827.

One of the unfigured paratypes of the Renz and Renz monograph is figured here on Plate 20, figures 14, 15. Neither of these small paratype specimens shows the umbilical nodes as present in the holotype, nor is the suture preserved. However, aside from the lack of nodes, the remaining features of the conch are identical to those of the holotype. The drawing of the suture (Renz and Renz, 1948: pl. 3, fig. 4b) is accurate and is reproduced here as Figure 26K.

Occurrence. *Subcolumbites* fauna, Maradovuno, Chios.

Repository. Holotype NHMB J13825; figured paratypes NHMB J13826 (Renz and Renz, 1948: pl. 3, fig. 11), NHMB J19550 (Pl. 20, figs. 14, 15); unfigured paratypes NHMB J13827.

Genus *Epiceltites* Arthaber, 1911
Type species, *Epiceltites gentii* Arthaber, 1911

Epiceltites gentii Arthaber
Plate 3, figures 10, 11; Plate 35, figures 6, 7; Text-figure 26

Epiceltites gentii Arthaber, 1911: 268, pl. 24(8), fig. 8; Diener, 1915: 131; C. Renz, 1928: 155; Kutassy, 1933: 510; Spath, 1934: 210, pl. 13, figs. 5a–d; Renz and Renz, 1947: 60; Renz and Renz, 1948: 43, pl. 1, figs. 9a–d.

Epiceltites n. sp. cf. *E. gentii*,—Kummel, 1954: 187.

Arthaber (1911) had five specimens of this unique species of which only the holotype (Pl. 3, figs. 10, 11) is still preserved in the Paleontological Institute, Vienna. The evolute, compressed conch with periodic flares or constrictions that are strongly projected forward on the venter makes identification of this species easier than with most species of Scythian ammonoids. The holotype measures 36.3 mm in diameter, 9.3 mm for the width of the last whorl, 12.8 mm for the height of the last

whorl, and 14 mm for the diameter of the umbilicus.

The *Subcolumbites* fauna of Chios also contains this species. The specimen figured by Renz and Renz (1948: pl. 1, fig. 9) measures 31 mm in diameter, 7.3 mm for the width of the last whorl, 10.3 mm for the height of the last whorl and 12.6 mm for the diameter of the umbilicus.

The Thaynes Formation of southeastern Idaho has yielded two incomplete and poorly preserved specimens. One specimen (Pl. 35, fig. 6) consists of only a portion of one side of the conch, thoroughly embedded in matrix; the other specimen (Pl. 35, fig. 7) shows only the venter and part of the lateral area of one-half volution. As no suture is preserved on either of the specimens, there has been some hesitation as to their specific identity. However, with due consideration of the preservation and incompleteness of the specimens, I feel that the shape and involution of the conch and the pattern of ornamentation are so similar to the specimens of this species from Albania and Chios that one must assign these specimens to Arthaber's species. Arthaber's suture is reproduced on Figure 26L.

Occurrence. The holotype is from the *Subcolumbites* fauna of Albania. The species is also known from that same fauna from Chios, and from the uppermost member of the Thaynes Formation, Hammond Creek, Bear River Range, southeastern Idaho.

Repository. Holotype, Paleontological Institute, Vienna; topotypes BMNH C-22867–74. Specimens from Chios, NHMB J13657 (Renz and Renz, 1948: pl. 1, fig. 9); unfigured specimens NHMB J13658, J13659. Specimens from southeastern Idaho MCZ 9470 (Pl. 35, fig. 6), MCZ 9471 (Pl. 35, fig. 7).

Epiceltites subgracilis (Astakhova)
Text-figure 26

Anasibirites subgracilis Astakhova, 1960a: 147, pl. 34, fig. 8, text-fig. 13.

The general shape etc. of the conch and the suture (Fig. 26M) is very much like that of the type species. The pattern of ornamentations is sufficiently different to warrant separation.

Occurrence. From *Columbites* Zone of Astakhova (1960a), Mangyshlak Peninsula.

Family USSURIIDAE Spath, 1930
Genus *Parussuria* Spath, 1934
Type species, *Ussuria compressa* Hyatt and Smith, 1905
Parussuria latilobata Chao

Parussuria latilobata Chao, 1959: 94, p. 260, pl. 31, figs. 14, 15, text-fig. 31.

The few species that previously have been assigned to this genus are of mid-Scythian age; this is the first species from a late Scythian horizon, and it is known from only a single specimen. Chao (1959: 261) concluded that his species was most closely related to *Parussuria iwanovi* (Diener, 1895) from the Primorye Region. In this I am in complete agreement; in fact, these two specimens could well be conspecific. Unfortunately, precise data on the stratigraphic position of *P. iwanovi* are lacking. This species was not in the faunas described by Kiparisova (1961) from the Primorye Region.

Occurrence. Limestone block in Lolou village, Kwangsi, China (Chao collection 542b).

Family HEDENSTROEMIIDAE Waagen, 1895
Genus *Metahedenstroemia* Spath, 1934
Type species, *Hedenstroemia kastriotae* Arthaber, 1911

This is a very unsatisfactorily defined genus because the type specimen is most probably an immature form of only modest preservation. Spath (1934) considered the suture to be the most unique aspect of his new genus. The suture as illustrated by Arthaber (1911) is highly idealized. As with practically all the specimens from the *Subcolumbites* fauna of Albania and Chios,

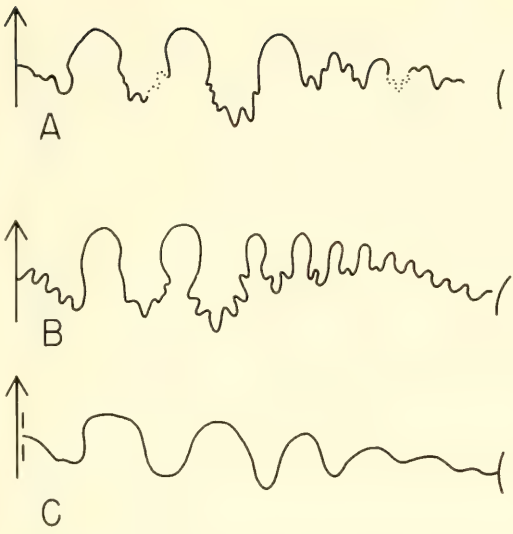


Figure 27. Diagrammatic representation of the suture of: A, holotype of *Metahedenstroemia kastriotae* (Arthaber), from the *Subcolumbites* fauna of Albania, at a diameter of 36 mm; B, holotype *Hedenstroemia pityoussae* Renz and Renz (1948: pl. 16, fig. 8b), from the *Subcolumbites* fauna of Chios, at a diameter of approximately 20 mm; C, holotype *Beatites berthae* Arthaber (1911), from *Subcolumbites* fauna of Albania, new drawing at a diameter of 32 mm.

the suture can be exposed only by grinding. In the case of the type specimen of this genus the grinding has been excessive. A new drawing of the suture, as exposed, is shown on Figure 27A. The Chios species, *Hedenstroemia pityoussae* Renz and Renz (1948), differs from the type species of *Metahedenstroemia* in details of the suture. However, as I believe the differences are due mainly to the results of specimen preparation and are more apparent than real, I consider the two species conspecific. This genus and species is known only from the *Subcolumbites* fauna of Albania and Chios.

Metahedenstroemia kastriotae (Arthaber)
Plate 14, figures 9, 10; Text-figure 27

Hedenstroemia kastriotae Arthaber, 1911: 208, p. 17(1), figs. 14a–c; Diener, 1915: 148.

Metahedenstroemia kastriotae,—Spath, 1934: 223, fig. 72; Kummel, *in* Arkell et al., 1957: L140, fig. 173, 10.

Hedenstroemia pityoussae Renz and Renz, 1947: 61, 78; Renz and Renz, 1948: 83, pl. 16, figs. 8–8b.

Arthaber (1911: 208) had two specimens of this species but only the specimen Spath (1934: 223) selected as the type of his genus *Metahedenstroemia* is still preserved in the Paleontological Institute, University of Vienna. This specimen is all phragmocone and measures 36.4 mm in diameter, 22.0 mm for the height of the last whorl, and 4.7 mm for the width of the last whorl. It is illustrated here on Plate 14, figures 9, 10 and the suture on Figures 27A, B.

The species *Hedenstroemia pityoussae* described by Renz and Renz (1948: 83) from the *Subcolumbites* fauna of Chios is based on three small fragmentary specimens. These authors differentiated their species on the basis of the suture; these differences are, however, partly due to preservation and preparation of the specimen.

Occurrence. *Subcolumbites* fauna of Albania and Chios.

Repository. Holotype is in the Paleontological Institute, Vienna; specimens from Chios, holotype, NHMB J13791; unfigured paratypes NHMB J13792.

Genus *Beatites* Arthaber, 1911
Type species, *Beatites berthae* Arthaber, 1911

Highly compressed, involute form with oxynote venter; sinuous growth lines. Suture long with low goniatitic lobes and saddles.

Beatites berthae Arthaber
Plate 21, figures 3, 4; Text-figure 27

Beatites berthae Arthaber, 1911: 210, pl. 17(1), fig. 15; Diener, 1915: 66; Diener, 1917: 169; Welter, 1922: 98; Kummel, *in* Arkell et al., 1957: L142, fig. 173, 4.

The dimensions of the holotype (and only specimen of this genus and species) are: Diameter 32.3 mm, Width 3.7 mm,

Height 16.0 mm, Umbilicus 5.8 mm. The specimen is essentially all phragmocone. The flanks of the penultimate half volution have the wrinkle layer well preserved. The suture has been exposed by grinding; whether this has affected the details of the lobes is not known. Arthaber's suture drawing is not as accurate as it should be and a new drawing is reproduced here on Figure 27C.

Occurrence. *Subcolumbites* fauna, Kčira, Albania.

Repository. Paleontological Institute, University of Vienna.

Genus *Lanceolites* Hyatt and Smith, 1905
Type species, *Lanceolites compactus* Hyatt and Smith, 1905

Until recently this genus has been known only from the *Meekoceras* limestone of Idaho, Nevada, and California. In addition to the type species, Smith (1932: 90) has described one other (*L. bicarinatus*) which is clearly closely related to the type species and may be conspecific with it. Neither of these species are very common in the *Meekoceras* limestone of western United States. Recently Ganev (1966) has described *L. discoidalis* on four specimens from the Campil Member of the Werfen Formation of eastern Bulgaria. As these forms are associated with a typical Werfen tirolitid fauna, they are considered to be of *Prohungarites* Zone age. This new record considerably extends the range of the genus.

Lanceolites discoidalis Ganev

Lanceolites discoidalis Ganev, 1966: 23, pl. 1, figs. 1, 2, 4.

The conch shape of this species is nearly identical to that of the species from the *Meekoceras* limestone of western United States. In this respect the Bulgarian species is more similar to *L. bicarinatus* than to *L. compactus*, which appears to have a slightly more inflated conch. However, so few specimens of any of these species are known that there are no data available on the amount of variability possible in conch inflation. The suture of *L. discoidalis* has the same basic pattern as that of the American species but details are quite different. Through the kindness of Dr. Ganev I have plastotypes of his specimens. I suspect, from studying these, that the lack of fine denticulations in the suture is the result of poor preservation and weathering. At the same time, the suture is not too unlike that of *L. bicarinatus* reproduced by Smith (1932: pl. 55, figs. 3, 5, 7, 10), or that of weathered specimens of *L. compactus* reproduced by Smith (1932: pl. 5, fig. 9).

Occurrence. Campil Member, Werfen Formation, perhaps as exotic blocks, Luda-Kamčija region of eastern Bulgaria.

Repository. Primary types in Geological Institute of the Bulgarian Academy of Science; plaster casts are in the MCZ.

Family MEEKOCERATIDAE Waagen, 1895

Genus *Svalbardiceras* Frebold, 1930
Type species, *Lecanites* (?) *spitzbergensis* Frebold, 1929

Svalbardiceras spitzbergensis (Frebold)
Plate 26, figures 1–4; Text-figure 28

Lecanites (?) *spitzbergensis* Frebold, 1929b: 299, pl. 1, fig. 1; Kutassy, 1933: 577.

Ammonites sp. indet. Frebold, 1929a: 14, pl. 1, fig. 12.

Ammonites sp. indet. Frebold, 1929a: 15, pl. 1, fig. 13.

Svalbardiceras spitzbergensis (Frebold), 1930: 24, pl. 6, figs. 1–3; Spath, 1934: 251, fig. 85; Kummel, *in* Arkell et al., 1957: L142.

Interpretation of this species has been in doubt amongst several authors, mainly due to the uncertainty as to the nature of the suture. The holotype is the specimen described by Frebold in 1929 (1929b: pl. 1, fig. 1) and not that figured by Frebold in 1930 (pl. 6, fig. 1–1a), as indicated by Spath (1934: 251). The holotype specimens came from Agardhberge on Storfjord, Spitsbergen. The specimens described by Frebold (1929a) as *Ammonites*

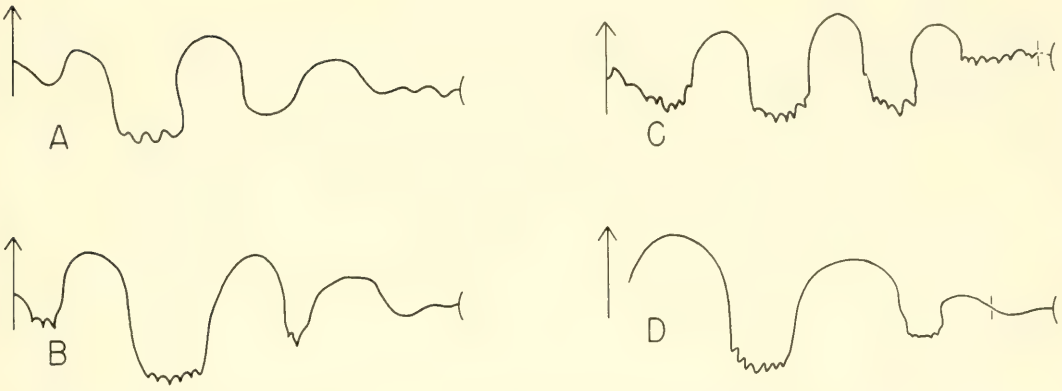


Figure 28. Diagrammatic representation of the sutures of several species of *Svalbardiceras*. A, topotype of *Svalbardiceras schmidti* (Mojsisovics), from *Olenekites* Zone, Olenek region, Siberia, at a whorl height of 13 mm (Popov, 1961: 39, fig. 6b); B, *Svalbardiceras* sp. indet., from Upper Thaynes Formation, Hammond Creek, southeastern Idaho, at a whorl height of 15 mm (MCZ 9488); C, holotype of *Svalbardiceras sheldoni* n. sp., from *Columbites* fauna, Thaynes Formation, Draney Creek, southeastern Idaho, at a diameter of 38 mm (MCZ 9493); D, *Svalbardiceras spitzbergensis* (Frebold, 1929a: pl. 1, fig. 13; Pl. 26, figs. 3, 4 of this report), from upper Scythian beds, Cape Thordsen, Spitsbergen, at a diameter of 37 mm.

sp. indet., which I believe to be conspecific with the holotype, came from Cape Thordsen. The specimens described in 1930 by Frebold came from Agardh Bay, Milne Edwardsberg, and Botneheia (Corrie Down). All these specimens came from what is interpreted as a late Scythian horizon. The specimens from Cape Thordsen were associated with a *Keyserlingites*.

All of the known specimens of this species show it to be an evolute form with compressed whorls, higher than wide, and with a flattened venter. The inner whorls bear slight radial ribs which are strongest near the umbilical shoulder and decrease down the flank; the weak ribs can be observed throughout the phragmocone. On the living chamber, the pattern of ornamentation is more irregular and is more like irregular bundled growth lines. The full details of the suture were not available to Frebold, but on one of his specimens—*Ammonites* sp. indet. (Frebold, 1929a: pl. 1, fig. 13; Pl. 26, figs. 3, 4 of this report)—it has been possible to develop the suture (Fig. 28D). The suture bears two lateral lobes that are clearly denticulated, and a smooth auxiliary lobe on the umbilical wall. The highly crystalline nature of the phragmocone on many of the Spitsbergen ammonites makes development of the suture generally very difficult.

This Spitsbergen species of *Svalbardiceras* is quite similar to the other species of the genus but tends to be more involute and with more development of an ornamentational pattern than the Siberian *S. schmidti*. The Idaho *S. sheldoni* has very different whorl dimensions and a more elaborate suture.

Occurrence. From presumably the uppermost Scythian horizon at Agardh Bay, Milne Edwardsberg, Botneheia (Corrie Down), and Cape Thordsen, Spitsbergen.

Repository. The holotype was in the Mineralogisch-Geologischen Staatsinstitut, Hamburg, but was destroyed in the great fire of 1943; the specimens described by Frebold (1929a) are in the Paleontologisk Museum, Oslo; the specimens described by Frebold (1930) are in the Geologisk Institut, Uppsala.

Svalbardiceras schmidti (Mojsisovics) Plate 26, figure 5; Text-figure 28

Xenodiscus schmidti Mojsisovics, 1886: 77, pl. 11, figs. 8–11.

Gyronites mojsisovicsi Waagen, 1895: 297 (=

Xenodiscus schmidti Mojsisovics, 1886: pl. 11, figs. 11a–c); Spath, 1934: 90, 251.
Prionolobus schmidti,—Noetling, *in* Frech, 1905: pl. 28, figs. 6a, b.
Meekoceras (Gyronites) schmidti,—Diener, 1915: 197.
Meekoceras sp. indet. Frebold, 1929a: 13, pl. 1, fig. 11.
Svalbardiceras spitzbergensis (Frebold) 1930: 24, pl. 6, fig. 2.
Gyronites (?) schmidti,—Kiparisova, 1947: 134, pl. 30, figs. 4, 5, text-fig. 16.
Svalbardiceras schmidti,—Tozer, 1961a: 32.
Nordophiceras schmidti,—Popov, 1961: 39, pl. 12, fig. 3.

Popov (1961: 39) recognized that his Siberian species was very similar to *Svalbardiceras spitzbergensis* (Frebold) but on the argument that the suture of this latter species was "unsatisfactorily defined" and that the suture was unknown he felt a comparison was not possible. It is true that no drawing of a suture was presented with the original description of *Lecanites (?) spitzbergensis* Frebold (1929b: 299, pl. 1, fig. 1), but they are visible on the photograph of the specimen. Frebold, however, interpreted the lobes as being goniatitic. The two specimens Frebold (1929a: 14, 15, pl. 1, figs 12, 13) described as *Ammonites* sp. indet. were considered by their author as most probably closely related to *Lecanites(?) spitzbergensis*; I believe them to be conspecific to that species. One of these specimens does preserve the suture (Fig. 28D) and this clearly shows denticulated lobes; the general pattern of the suture is identical to that shown on the photograph of the holotype (Frebold, 1929b: pl. 1(36), fig. 1). It does not, on this basis, seem justified to disregard *Svalbardiceras* as a valid generic name.

Acceptance of *Svalbardiceras* can and does clarify the genus *Nordophiceras* Popov (1961) from the Olenek region, Siberia. Within this new genus, Popov (1961) included a variety of species described by Mojsisovics (1886) as *Xenodiscus schmidti, Xenodiscus dentosus, Xenodiscus euomphalus* and the holotype, *Xenodiscus karpinskii*; in addition, Popov (1961) described one new species, *Nordophiceras alexeevae*. Thus within his genus *Nordophiceras*, Popov (1961) combined what I consider to be a heterogeneous assemblage of species. The group includes round ventered forms as illustrated by *Xenodiscus karpinskii*, the holotype of *Nordophiceras*, and forms with truncate venters as illustrated by *Xenodiscus schmidti* and *X. dentosus*. It is this latter group which is more properly allied to the Spitsbergen species of *Svalbardiceras*.

Mojsisovics (1886) illustrated three specimens of his *Xenodiscus schmidti*; the principal variation observable is in the sharpness of the ventral shoulders. Waagen (1895: 297) renamed the form shown on Mojsisovics' plate 11, figure 11a, b, as *Gyronites mojsisovicsi*. This additional name did not add clarity to the understanding of the group. Spath (1934: 251) lists the specimen of Mojsisovics (1886: pl. 11, fig. 8a, b) as lectotype.

Of the species of *Nordophiceras* described by Popov (1961), his specimen of *Nordophiceras schmidti* (Fig. 28A) is like that of Mojsisovics (1886: pl. 11, fig 9) in which the venter is slightly rounded but the ventral shoulders still quite distinct. I would, however, also include in this species *Meekoceras* sp. indet. Frebold (1929a: pl. 1, fig. 11; Pl. 26, fig. 5 of this report). This specimen has the very flat venter with angular ventral shoulders shown by Mojsisovics' specimen of *schmidti* on his plate 11, figure 11. Likewise the abrupt umbilical shoulder and the nature of the growth lines are nearly identical. The suture is unfortunately not preserved. In addition, the specimen of *Svalbardiceras spitzbergensis* (Frebold, 1930: pl. 6, fig. 2) should be included. Both of these specimens differ from the other Spitsbergen specimens assigned to *S. spitzbergensis* in being more involute and having a higher height-width relationship in the whorl dimensions. This is the primary difference between *S. schmidti* and *S. spitzbergensis*. The general

conch form of S. *sheldoni* is like that of S. *schmidti,* but in this species there are conspicuous transverse ribs on the venter and differences in the spacing of the suture elements.

Occurrence. Mojsisovics' species are only listed as coming from the region of the mouth of the Olenek River. Popov (1961) lists his specimens as from his *Olenekites* Zone. Frebold's specimen of *Meekoceras* sp. indet. is from Cape Thordsen, associated with *Keyserlingites;* his specimen of *Svalbardiceras spitzbergensis* (Frebold, 1930: pl. 6, fig. 2) is from Milne Edward Mountain.

Repository. The only specimen of this species personally handled is Frebold's *Meekoceras* sp. indet., and this is in the Paleontological Museum, Oslo, Norway.

Svalbardiceras sibiricum (Mojsisovics)

Meekoceras sibiricum Mojsisovics, 1886: 85, pl. 11, figs. 1–6; Spath, 1934: 224, 246, 254, 274, 341.
Aspidites sibiricus,—Frech, 1905: pl. 28, fig. 11.
Meekoceras (Koninckites) sibiricum,—Diener, 1915: 198.
Meekoceras ? sibiricum,—Kiparisova, 1947: 150, pl. 35, fig. 2.
Hemiprionites sibiricus,—Popov, 1962a: 176, 187, pl. 2, fig. 3.

This species has been a puzzle to most students of Triassic ammonoids. Tozer (1965a: 37) suggested assignment of this species to *Svalbardiceras* and I believe there is much merit in this suggestion. The umbilical width of slightly less than 10 percent the diameter of the conch makes this the most involute species of the genus. As already pointed out by Tozer (1965a: 37), Popov's (1962a) assignment of this species to *Hemiprionites* cannot stand for many reasons.

Occurrence. Olenek fauna, mouth of Olenek River, northern Siberia.

Svalbardiceras dentosus (Mojsisovics)

Xenodiscus dentosus Mojsisovics, 1886: 78, pl. 11, figs. 12a, b.
Goniodiscus dentosus,—Diener, 1915: 135; Spath, 1934: 330.

This species is like S. *schmidti* except for long, low clavi along the sharp ventral shoulders. It is based on a single specimen.

Occurrence. From near the mouth of the Olenek River.

Svalbardiceras freboldi Tozer

Svalbardiceras freboldi Tozer, 1965a: 36, pl. 4, figs. 12, 13, pl. 5, fig. 2, text-fig. 11.

With an umbilical width approximately 20 percent the diameter of the conch, this is one of the more involute species of *Svalbardiceras.* Aside from the slightly greater involution, it is very similar to *schmidti* and *spitzbergensis.*

Occurrence. Uppermost Scythian, Blaa Mountain Formation, lower shale member, northern Ellesmere Island.

Svalbardiceras chowadei Tozer

Svalbardiceras chowadei Tozer, 1965a: 37, pl. 4, figs. 9–11.

This species could very well be conspecific with S. *spitzbergensis.* The differences are mainly in a slight difference in the degree of involution. However, with both species the number of specimens known is so small that really no data are available on the range of variability of any of the morphological features.

Occurrence. Toad Formation, Halfway River area, British Columbia.

Svalbardiceras sheldoni n. sp.
Plate 43, figure 1; Text-figure 28

The *Columbites* fauna of southeastern Idaho has yielded three specimens which form the basis for this new species. The two larger specimens are embedded in matrix with only one side completely exposed and a portion of the venter on the phragmocone, and the body chamber exposed. The body chamber is crushed. The holotype specimen measures 70 mm in diameter; the height of the adoral volution is 30 mm and the umbilicus has a diameter of 22.7 mm. The conch is evolute, compressed, and essentially smooth. The

venter is flat, and aligned by angular ventral shoulders. The lateral areas are broadly convex with the maximum breadth at about mid-way between the ventral and umbilical shoulders. The umbilical shoulders are likewise sharply rounded and the umbilical wall is vertical. The body chamber occupies approximately two-thirds of a volution. The shell bears fine growth lines that are slightly prosiradiate. On the phragmocone the venter has narrow, shallow, transverse grooves that extend from one ventral shoulder to the other.

The suture is shown on Figure 28C. It consists of a wide ventral lobe, highly denticulated, two lateral lobes, and a serrated shallow lobe adjacent to the umbilical shoulder. The large paratype has an inner core of 59 mm in diameter of excellent preservation. Attached to it is a portion of body chamber with a whorl height of 39 mm. The specimen must have had a diameter of at least 100 mm. The small paratype has a diameter of 25.2 mm, and the whorl shape of the large specimens. At a diameter of 4 mm the venter is rounded; it appears that in the following volutions the venter begins to become flattened.

This species has a remarkable similarity to *Svalbardiceras schmidti* (Mojsisovics, 1886: 77, pl. 11, figs. 11a, b), that is, in the identity of the greatly compressed, evolute conch, and the flattened venter. *Svalbardiceras schmidti* appears to have a smooth venter, lacking transverse furrows. The essential plan of the suture is the same except that the ventral lobe lies within the venter and does not spread out on the lateral areas as in *S. sheldoni*. Mojsisovics noted a fair degree of variability in the nature of the venter of his species, some forms having rounded venters and ventral shoulders. This observation has been confirmed by Popov (1961).

The Spitsbergen species, *S. spitzbergensis* (Frebold, 1930: 24, pl. 6, figs. 1–3) tends to be slightly more inflated than the species described here. Likewise, the lateral area bears weak radial ribs, widely spaced on the inner whorls, but becoming more bunched and sinuous on the body chamber. The venter bears weak transverse furrows.

Occurrence. From middle shale member of Thaynes Formation (*Columbites* fauna), on hillside north of Sage Creek, Stewart Flat Quadrangle, and at Hot Springs, southeast Idaho.

Repository. Holotype MCZ 9493; paratypes MCZ 9643, 9644.

Svalbardiceras sp. indet. (S.E. Idaho)
Text-figure 28

Svalbardiceras sp. Kummel, 1954: 187.

This specimen is recognized on the basis of a fragment of phragmocone consisting of only five camerae. The whorl height is 14 mm, and the width is 7.3 mm. The cross section of the whorl is compressed, the lateral areas broadly convex. The venter is slightly concave, measuring about 2 mm in breadth, and lined by angular ventral shoulders. The umbilical shoulder is broadly rounded. The suture is shown on Figure 28B. The specimen recorded here is much too fragmentary to compare in a detailed fashion with the Spitsbergen and Olenek species, but in its whorl shape and suture it agrees well with the basic conch pattern for the genus.

Occurrence. Upper member Thaynes Formation, Hammond Creek, Bear River Range, southeast Idaho.

Repository. MCZ 9488.

Svalbardiceras sp. indet. (Pakistan)

Svalbardiceras sp. indet., Kummel, 1966: 394, pl. 2, figs. 6–9.

This identification was based on a complete phragmocone and a fragment of another. The specimens are complete enough to confidently assign them to the genus *Svalbardiceras* but are not sufficiently complete to make any meaningful comparisons with other species of the genus.

Occurrence. Narmia Member of Mian-

wali Formation, Nammal Gorge, Salt Range, West Pakistan.

Repository. MCZ 9587, 9588.

Genus *Stacheites* Kittl, 1903
Type species, *Stacheites prionoides* Kittl, 1903

Compressed, involute forms with tabulate, often sulcate venter. Suture with prominent first lateral lobe and shallow, broad, second lateral lobe; first lateral saddle narrow, second lateral saddle broadly rounded.

The type specimens came from the Werfen Formation in Dalmatia. The type species, S. *prionoides*, is also stated to occur in the Mangyshlak Peninsula in the Caspian region, but unfortunately no specimens from there have been described or illustrated (Astakhova, 1960b). A second species, S. *floweri*, from the *Subcolumbites* fauna of the Tobin Formation of Nevada is described here. An indeterminate species is known from the Narmia Member of the Mianwali Formation in the Salt Range of West Pakistan (Kummel, 1966); likewise, two specifically indeterminate forms are recorded from the Thaynes Formation of southeastern Idaho.

Stacheites dionysi (Renz and Renz, 1948: 50) is here considered to be a synonym of *Metadagnoceras terbunicum* (Arthaber). I agree with Spath (1934: 267) that *Stacheites webbianus* Diener (1907) from the Himalayan Anisian is a completely unrelated stock to the Scythian species discussed here.

Stacheites prionoides Kittl
Plate 56, figures 9, 10; Text-figure 29

Stacheites prionoides Kittl, 1903: 27, pl. 4, fig. 8; Diener, 1915: 266; Spath, 1934: 267, fig. 92.

Kittl's original figure was a highly reconstructed drawing with no view of the venter. The type specimen is illustrated here for the first time. It can be seen that the specimen is a compressed form but obviously crushed. The opposite side of the conch is completely missing. The

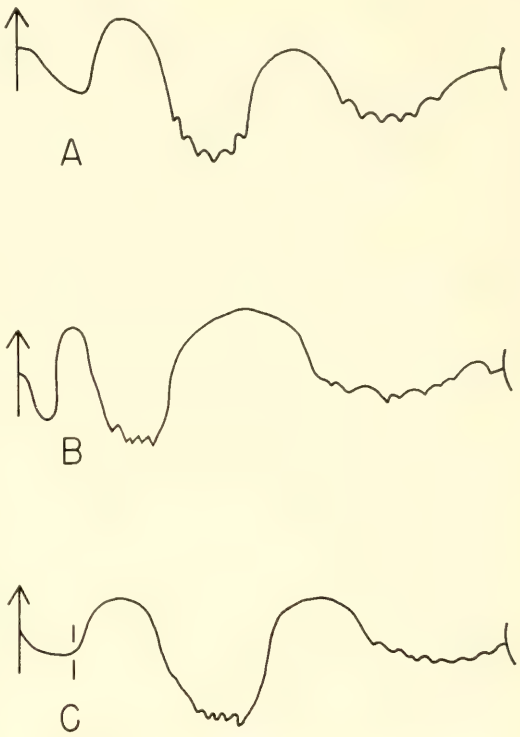


Figure 29. Diagrammatic representation of the suture of: A, *Stacheites prionoides* Kittl (1903: pl. 4, fig. 8), at a diameter of 33 mm, from Werfen Formation, Dalmatia; B, *S. floweri* n. sp., composite suture from specimens MCZ 9439 and 9491, at a diameter of approximately 35 mm, from *Subcolumbites* fauna, Tobin Formation, Nevada; C, S. sp. indet. II, at a diameter of 21 mm, from uppermost Thaynes Formation, Sublette Ridge, western Wyoming (MCZ 9501).

venter is narrow, flattened and sulcate, bordered by acute ventral shoulders. The measurements of Kittl's type are as follows:

D	W	H	U	W/D	H/D	U/D
45.8	?	24.2	5.0	?	52.8	10.9

The suture is slightly weathered and the ventral lobe could well be denticulated, but is too weathered to preserve such features. I consider Kittl's illustrations a fairly good representation of this specimen.

Stacheites prionoides is morphologically quite similar to the only other species of the genus, S. *floweri*, from the Tobin Formation of Nevada. The sutures especially are similar (Fig. 29). The shape

TABLE 40. MEASUREMENTS OF *STACHEITES FLOWERI* N. SP. FROM TOBIN FORMATION, NEVADA.

	D	W	H	U	W/D	H/D	U/D
1.	48.5	?	25.7	5.2?	?	52.9	10.6?
2.	40.5	?	20.8	5.5	?	50.2	13.2
3.	39.7	10.5	22.0	3.9	26.45	54.0	9.9
4.	31.7	8.2?	17.1	3.0	25.9?	53.9	9.48
5.	28.5	8.2?	16.7	2.6	28.75?	58.6	9.1

1. Paratype, MCZ 9440 (Pl. 28, fig. 2).
2. Paratype, MCZ 9444 (Pl. 28, fig. 8).
3. Holotype, MCZ 9441 (Pl. 28, figs. 3, 4).
4. Paratype, MCZ 9445 (Pl. 28, fig. 9).
5. Paratype, MCZ 9443 (Pl. 28, figs. 6, 7).

of the conch, degree of inflation and involution are also strikingly similar. The Nevada species, however, does bear faint sigmoidal ribs on the flanks whereas *S. prionoides,* as far as can be told, is smooth. Astakhova (1960b) records this species from the Mangyshlak Peninsula; in fact she used this as the name species of her highest local zone. Unfortunately, no descriptions or illustrations of these Mangyshlak specimens are available.

Occurrence. Werfen Formation, Muć, Dalmatia.

Repository. The holotype and only specimen of this species is in the Natural History Museum, Vienna.

Stacheites floweri n. sp.
Plate 28, figures 1–10; Text-figure 29

This is the second species of the genus *Stacheites* to be recorded. The species is represented by a fairly large number of specimens, mainly fragmentary. The measurements of five of the most complete specimens are given on Table 40.

The conch is very involute and discoidal. The venter is narrow, typically slightly concave, and bordered by a fairly sharp ridge. In some forms (e.g. Pl. 28, figs. 6, 7) the venter loses its concavity, and the adjoining ventral shoulders are rounded and not angular; on the earlier volutions, however, the former condition prevails. The material available does not allow an evaluation as to the nature and extent of variations in the character of the venter.

The flanks are slightly arched, with the maximum width in the dorsal third of the flank. The umbilical shoulders are abruptly rounded, and the umbilical wall vertical. The flanks bear interesting low falciform ribs. These commence above the umbilical shoulders as very low, narrow, radial ribs. At about the mid part of the flanks, the ribs broaden greatly, and inscribe a concave arc. Where the venter is concave, it is perfectly smooth; on the specimen (Pl. 28, figs. 6, 7) where the venter is not concave, there are faint ridges crossing the venter. In some specimens the falciform ribs are extremely faint.

The suture consists of a fairly broad first lateral lobe, a second lateral saddle occupying about one-third of the width of the flank, and a second lateral lobe that is low, and with a characteristic pattern of denticulation (Fig. 29B).

The basic features of the conch and suture place this species morphologically very close to *S. prionoides.* The falciform ribs are the most obvious distinguishing features.

Occurrence. Tobin Formation, Pershing County, Nevada; south tip of Tobin Range, Cain Mountain 1:62,500 quad., center NW ¼ sec. 9, T. 26N, R. 39E, 5,500 ft. S, 27.5 ft. W from elevation point 5088 on range crest.

Repository. Holotype, MCZ 9441 (Pl. 28, figs. 3, 4); paratypes MCZ 9442 (Pl. 28, fig. 5), MCZ 9443 (Pl. 28, figs. 6, 7), MCZ 9444 (Pl. 28, fig. 8), MCZ 9445 (Pl. 28, fig. 9), MCZ 9446 (Pl. 28, fig. 10), MCZ 9439 (Pl. 28, fig. 1), MCZ 9440 (Pl. 28, fig. 2); suture specimen MCZ 9491; unfigured paratypes MCZ 9500.

Stacheites sp. indet. (S.E. Idaho)
Plate 37, figs. 7–10; Text-figure 29

Two specimens from the Thaynes Formation of southeastern Idaho can be assigned to *Stacheites.* The first of these specimens (Pl. 37, figs. 7, 8) is a weathered individual of only a quarter volution. The narrow concave venter, angular ventral

shoulder, slender compressed conch and distinctive suture are characteristic of the genus. The specimen is too incomplete to allow a specific determination or comparison.

The second specimen (Pl. 37, figs. 9, 10) is a small weathered individual of 33.6 mm in diameter that could well be conspecific with *Stacheites floweri* of the Tobin Formation of Nevada. The venter is flat with angular ventral shoulders. The lateral areas are broadly convex and smooth. The adoral half of the specimen is body chamber. The suture is shown on Figure 29C. The suture is quite similar to that of *S. floweri* except in the ventral lobe, but the differences here could well be the result of weathering.

Occurrence. The first specimen (Pl. 37, figs. 7, 8) came from the Upper Thaynes Formation, Hammond Creek, Bear River Range, southeast Idaho. The second specimen (Pl. 37, figs. 9, 10) came from a float 150–200 feet from top of upper calcareous siltstone member of Thaynes Formation (Kummel, 1954), Spring Canyon, Sublette Ridge, western Wyoming.

Repository. MCZ 9487 (Pl. 37, figs. 7, 8), MCZ 9501 (Pl. 37, figs. 9, 10).

Stacheites sp. indet. (West Pakistan)

Stacheites sp. indet., Kummel, 1966: 396, pl. 3, fig. 13.

This record is based on a single, poorly preserved specimen. The basic conch outline and pattern of suture generically identify the specimen.

Occurrence. The single specimen came from a five-foot limestone bed 38 feet above the base of the Narmia Member of the Mianwali Formation, Narmia Nala, Surghar Range, West Pakistan.

Repository. MCZ 9609.

Genus *Dagnoceras* Arthaber, 1911
Type species, *Dagnoceras nopcsanum* Arthaber, 1911

When Arthaber established this genus he included within it a varied group of species which are as follows:

Dagnoceras nopcsanum Arthaber
Dagnoceras zappanense Arthaber
Dagnoceras terbunicum Arthaber
Dagnoceras komanum Arthaber
Dagnoceras lejanum Arthaber

As Arthaber (1911) did not select a type species, Diener (1915: 115) selected *D. nopcsanum.* This selection was apparently overlooked by Smith (1932: 65) who selected *D. komanum* as type on the principle that this was the first mentioned species; this is, of course, an invalid selection.

Interpretation of the genus then rests first on a consideration of *D. nopcsanum.* The principal features are a moderately involute conch, with rounded flanks, a rounded umbilicus, and a suture with a large first lateral lobe and small second lateral lobe on or near the umbilical shoulder. Arthaber's (1911) sutures of this group were not accurately reproduced, and new drawings of his type specimens are offered here (Fig. 30). The sutures of all these specimens are to a greater or lesser extent altered by excessive grinding and polishing. *Dagnoceras nopcsanum* and *D. zappanense* are congeneric and actually quite similar. These two species differ mainly in the width of the first lateral lobe. *Dagnoceras lejanum* is a synonym of *D. zappanense. Dagnoceras komanum* is completely different in the aspect of the conch morphology and suture and is considered here to be a representative of *Albanites triadicus.* The specimen Arthaber (1911: 254, pl. 22(6), fig. 8) assigned to *Pseudosibirites* cf. *dichotomus* Waagen is also considered to be *Albanites triadicus.* Finally, there is *D. terbunicum,* a species with a narrow truncate venter and with a more elaborate suture. This species is assigned to *Metadagnoceras.* This genus is characterized by elaborate denticulation of the first lateral saddle and first lateral lobe. The conch is not too unlike that of a species

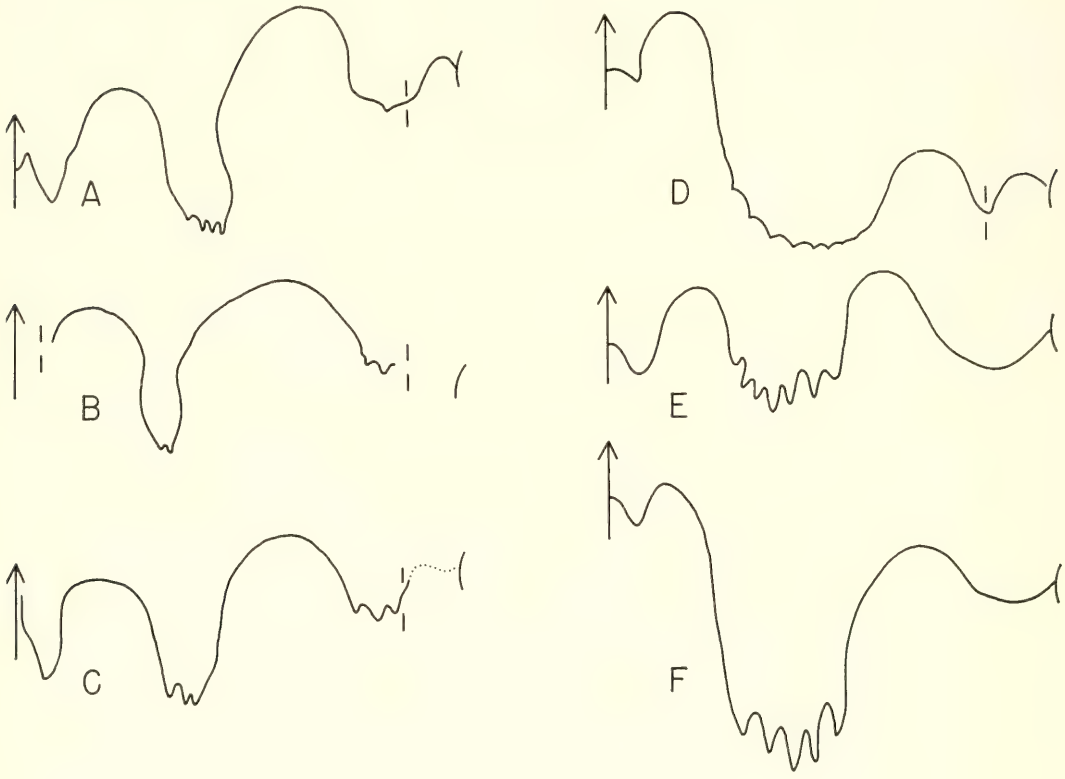


Figure 30. Diagrammatic representation of the sutures of species of *Dagnoceras*. A, syntype of *D. zappanense* Arthaber (1911: pl. 21(5), fig. 8; Pl. 15, figs. 3, 4 of this report), original drawing at a whorl height of 8 mm; B, syntype of *D. zappanense* Arthaber (1911: pl. 21(5), fig. 9; Pl. 15, figs. 5, 6 of this report), original drawing at a whorl height of 11.5 mm; C, syntype of *D. lejanum* Arthaber (1911: pl. 21(5), fig. 13; Pl. 15, figs. 7, 8 of this report), original drawing at a whorl height of 11 mm; D, holotype of *D. nopcsanum* Arthaber (1911: pl. 21(5), fig. 6; Pl. 15, figs. 1, 2 of this report), original drawing at a whorl height of 9 mm; E, *D. ellipticum* Chao (1959: fig. 47a), at a whorl height of 10 mm; F, *D. latilobatum* Chao (1959: fig. 47b), at a whorl height of 8 mm.

Specimens of figures A–D from *Subcolumbites* fauna of Albania; specimen of figure E from isolated block containing typical upper Scythian fauna in Kwangsi, China; specimen of figure F from a *Subcolumbites* fauna in Fengshan District of Kwangsi, China.

of *Dagnoceras*, but some species do have truncate venters, at least during a part of their ontogeny. *Metadagnoceras* appears to be a valid genus, distinct from *Dagnoceras*. However, it needs to be emphasized that the sutures of the two type specimens of *D. nopcsanum* are affected by grinding and polishing, and one cannot be sure as to how much these factors have given the suture its apparent simple pattern. None of the specimens of *D. nopcsanum* in the British Museum (Natural History) show the suture.

In addition to Albania, *Dagnoceras* is known from a single specimen (*D. zappanense*) from the *Prohungarites* fauna of Timor. The genus is known also from two species from late Scythian faunas in Kwangsi, China. A fragmentary specimen assigned to *D.* cf. *zappanense* has been recorded from the Narmia Member of the Mianwali Formation in the Surghar Range of West Pakistan (Kummel, 1966). It is of interest to note that no species of this genus has been recorded from the *Subcolumbites* fauna of Chios. *Dagnoceras*

(?) *unicum* Kiparisova from the Primorye Region is here assigned to *Metadagnoceras*. The three species from the *Meekoceras* fauna of southeastern Idaho that Smith (1932) assigned to *Dagnoceras* (*D. bonnevillense*, *D. bridgesi*, and *D. haydeni*) are completely unlike the type species and are excluded from this genus.

Dagnoceras nopcsanum Arthaber
Plate 15, figures 1, 2; Plate 16, figures 1, 2; Text-figure 30

Dagnoceras nopcsanum Arthaber, 1911: 241, pl. 21(5), figs. 6, 7; Diener, 1915: 115; Spath, 1934: 268–271, pl. 8, fig. 1, text-fig. 93a; Kummel, *in* Arkell, et al., 1957: L144, fig. 175, 1.

The two specimens of this species that Arthaber figured are the only specimens remaining in the original collection. They have the following measurements:

	D	W	H	U	W/D	H/D	U/D
Holotype (Arthaber, 1911: pl. 21(5), fig. 6)	28.5	9.1	11.1	10.0	49.2	38.9	35.1
Paratype (Arthaber, 1911: pl. 21(5), fig. 7)	36.3?	?	16.2	11.2	?	44.6?	30.9?

The holotype is a specimen of only fair preservation. The conch is evolute with a broad and fairly deep umbilicus. The whorls are oval in cross-section with a narrowly rounded venter, broadly convex lateral areas, an acutely rounded umbilical shoulder, and a steep umbilical wall. The greatest width of the whorls is at the umbilical shoulder. The specimen is essentially all phragmocone and devoid of any ornamentation or growth lines. The suture is shown on Figure 30D. As with all the specimens from the *Subcolumbites* fauna of Albania, the suture is revealed only by grinding and polishing, and in this case it is not possible to evaluate the full extent of the damage. The paratype has been so badly ground and polished that the suture is essentially meaningless. The holotype was prepared in slightly less damaging fashion but there is grave uncertainty as to whether the first lateral saddle and the first lateral lobe are as simple as shown on Figure 30D. The character of this part of the suture is critical for determining the relations of this species to those species assigned to *Metadagnoceras*.

Of the five species established by Arthaber from the Albanian Kčira fauna, only the type, *D. nopcsanum*, and *D. zappanense* are accepted as valid members of *Dagnoceras*. *Dagnoceras nopcsanum* differs from *D. zappanense* mainly in the suture, especially in the character of the first lateral lobe (Fig. 30B, D).

Occurrence. *Subcolumbites* fauna, Kčira, Albania.

Repository. Arthaber's two figured specimens are in the Paleontological Institute, University of Vienna.

Dagnoceras zappanense Arthaber
Plate 15, figures 3–11; Plate 24, figures 4, 5; Text-figure 30

Dagnoceras zappanense Arthaber, 1911: 241, pl. 21(5), figs. 8, 9; Diener, 1915: 115; Spath, 1934: 268–271, pl. 7, fig. 2, text-fig. 93d, e, f.
Dagnoceras cf. *zappanense*,—Kummel, 1966: 396, pl. 3, figs. 9, 10.
Dagnoceras lejanum Arthaber, 1911: 242, pl. 21(5), figs. 12, 13; Diener, 1915: 115; Spath, 1934: 269 (footnote), 271, text-fig. 93c.

The four specimens of this species figured by Arthaber are available for study. This species differs from *D. nopcsanum* mainly in the very slender first lateral lobe (Figs. 30A, B). In addition, there is some ornamentation. One specimen (Pl. 15, fig. 11) has faint umbilical nodes, and another faint sigmoidal ribs (Pl. 15, fig. 6). The other two specimens are smooth, which may be due to preservation or excessive preparation.

Arthaber distinguished between *D. zappanense* and *D. lejanum* on the basis of degree of involution and ornamentation. Both these characters are known to be highly variable in most ammonite species, and though the sample available is much too small to see "gradations," it is felt

that we are dealing here with a single species complex.

The measurements of the four illustrated types are as follows:

	D	W	H	U	W/D	H/D	U/D
1.	42.7	12.1	17.5	13.3	28.3	40.9	31.1
2.	37.2	12.3	18.4	9.1	33.1	49.5	24.5
3.	33.1	11.5	16.2	7.2	34.7	48.9	21.8
4.	30.1	10.7	13.7	8.5	35.5	45.5	28.2

1. Lectotype, *D. lejanum* Arthaber (1911: pl. 21(5), fig. 13).
2. Lectotype, *D. zappanense* Arthaber (1911: pl. 21(5), fig. 9).
3. Paralectotype, *D. zappanense* Arthaber (1911: pl. 21(5), fig. 8).
4. Paralectotype, *D. lejanum* Arthaber (1911: pl. 21(5), fig. 12).

The sutures of these two species are likewise nearly identical (Figs. 30A, C). Arthaber's drawings of the sutures for these species are deceptive; his drawing of the suture of *D. zappanense* (Fig. 30B) actually terminates on the umbilical shoulder, while that for *D. lejanum* (Fig. 30C) terminates on the umbilical seam.

The specimen from Timor identified by Spath (1934: 271, 272) as inseparable from *D. lejanum* is figured here on Plate 24, figures 4, 5. I completely agree with Spath on this conclusion; the specimen, though smaller, is nearly identical to the smaller paralectotype of *D. lejanum* illustrated here on Plate 15, figures 9–11. A fragmentary specimen of a form quite similar to this species has been recorded by Kummel (1966) from the Narmia Member of the Mianwali Formation, Surghar Range, West Pakistan, in association with *Procarnites kokeni*.

Occurrence. *Subcolumbites* fauna, Kčira, Albania, *Albanites* fauna, Nifoekoko, Timor; Narmia Member of Mianwali Formation, Surghar Range, West Pakistan.

Repository. The four types of Arthaber's are in the Paleontological Institute, University of Vienna; the specimen from Timor is BMNH C33713; the specimen from West Pakistan is MCZ 9565.

Dagnoceras latilobatum Chao
Text-figure 30

Dagnoceras latilobatum Chao, 1959: 142, 322, pl. 18, figs. 6–8.

This species was founded on two specimens with a "narrow, subtruncate venter" and "obtusely rounded" ventral shoulders. The suture (Fig. 30F) is characterized by a very large first lateral lobe. On the basis of the data available, I believe it to be a valid species of this genus.

Occurrence. From black, thick-bedded limestone about 1.5 km north of Yali, Kwangsi, China, associated with *Subcolumbites*, *Hellenites*, etc. (Chao collection 546).

Dagnoceras ellipticum Chao
Text-figure 30

Dagnoceras ellipticum Chao, 1959: 143, 323, pl. 18, figs. 3–5, text-fig. 47a.

This species is based on a single specimen which, however, is poorly illustrated. From the data available, it is clearly a species of *Dagnoceras* of the general type of *nopcsanum*, the type species. It differs from *nopcsanum* in its suture (Fig. 30E) but not enough data are available to analyze the relationships.

Occurrence. Upper limestone bed, Naliling section near village of Lolou, Linglo District, Kwangsi, China, associated with *Hellenites*, *Prenkites*, etc. (Chao collection 542a).

Genus *Metadagnoceras* Tozer, 1965
Type species, *Metadagnoceras pulcher* Tozer, 1965

This genus is characterized by its large, highly denticulated first lateral lobe and narrow first lateral saddle, that may or may not be denticulated. This basic plan of the suture is like that of *Dagnoceras* except for the pattern of denticulation. The suture of *Dagnoceras nopcsanum* is known only from the type specimen, and this suture has been affected by grinding. Taking this into consideration, the dif-

ferences between *Dagnoceras* and *Metadagnoceras* in regards to the suture are not all that great.

The genus *Metadagnoceras* includes the following species:

M. pulcher Tozer
M. tobini n. sp.
M. unicum (Kiparisova)
M. freemani Kummel
M. terbunicum (Arthaber)

Metadagnoceras pulcher occurs in the Toad Formation of British Columbia closely associated with species of *Isculitoides* and *Keyserlingites*; *Metadagnoceras tobini* is from the Tobin Formation of Nevada, associated with *Subcolumbites* etc.; *Metadagnoceras unicum* is from the Primorye Region, presumably from a late Scythian horizon (*Columbites* Zone); *Metadagnoceras freemani* is from the *Prohungarites* fauna of Timor; and *Metadagnoceras terbunicum* is from the *Subcolumbites* fauna of Albania and Chios.

This newly recognized genus is as yet incompletely known; three of the species (*unicum, freemani,* and *pulcher*) are known from only one specimen, and the other two species by a few specimens of only modest preservation.

Metadagnoceras pulcher Tozer
Text-figure 31

Metadagnoceras pulcher Tozer, 1965a: 29, pl. 1, figs. 11a–e.

This unique species was based on a single, well preserved specimen. It is readily differentiated by its suture (Fig. 31A) and its delicate strigate sculpture.

Occurrence. Toad Formation, Halfway River area, British Columbia.

Metadagnoceras tobini n. sp.
Plate 27, figures 1–4; Text-figure 31

This species is based on four fragmentary specimens of fair preservation. The conch is moderately involute with compressed whorls. The lateral areas are broadly arched, the venter low but rounded and bordered by rounded but distinct ventral shoulders. The umbilical shoulder is more abruptly rounded and the umbilical wall is nearly vertical. The flanks bear sinuous growth lines and the living chamber of one of the larger specimens has faint indications of widely separated low radial undulations. The venter on the two largest specimens is unfortunately not preserved; it is assumed that in these mature specimens the venter is like that of the smaller specimen illustrated on Plate 27, figures 1, 2.

The suture (Fig. 31B) consists of a large first lateral lobe which has denticulations extending up the ventral side to a narrow and irregular first lateral saddle. There is a second lateral lobe on the umbilical shoulder and wall. The second lateral saddle is asymmetric and rounded.

In its conch shape and dimensions, *Metadagnoceras tobini* is distinct from all the other species of this genus. However, its suture is nearly identical to the suture of *M. freemani* (Fig. 31D).

Occurrence. Lower part of Tobin Formation, USGS Locality M2562, Pershing County, Nevada; south tip of Tobin Range, Cain Mountain 1:62,500 quad., center NW ¼ sec. 9, T. 26N, R. 39E, 5,500 ft. S, 27.5 ft. W of elevation point 5088 on range crest.

Repository. Holotype (Pl. 27, fig. 3) MCZ 9637; paratypes (Pl. 27, figs. 1, 2) MCZ 9638, (Pl. 27, fig. 4) MCZ 9639; unfigured paratype MCZ 9640.

Metadagnoceras unicum
Text-figure 31

Dagnoceras (?) *unicum* Kiparisova, 1961: 74, pl. 13, fig. 6, text-fig. 35.

This species was based on a single well preserved specimen. In its general conch morphology it differs from other species of the genus in the great width of the whorl in the area of the umbilical shoulder, in the strongly converging whorl sides and

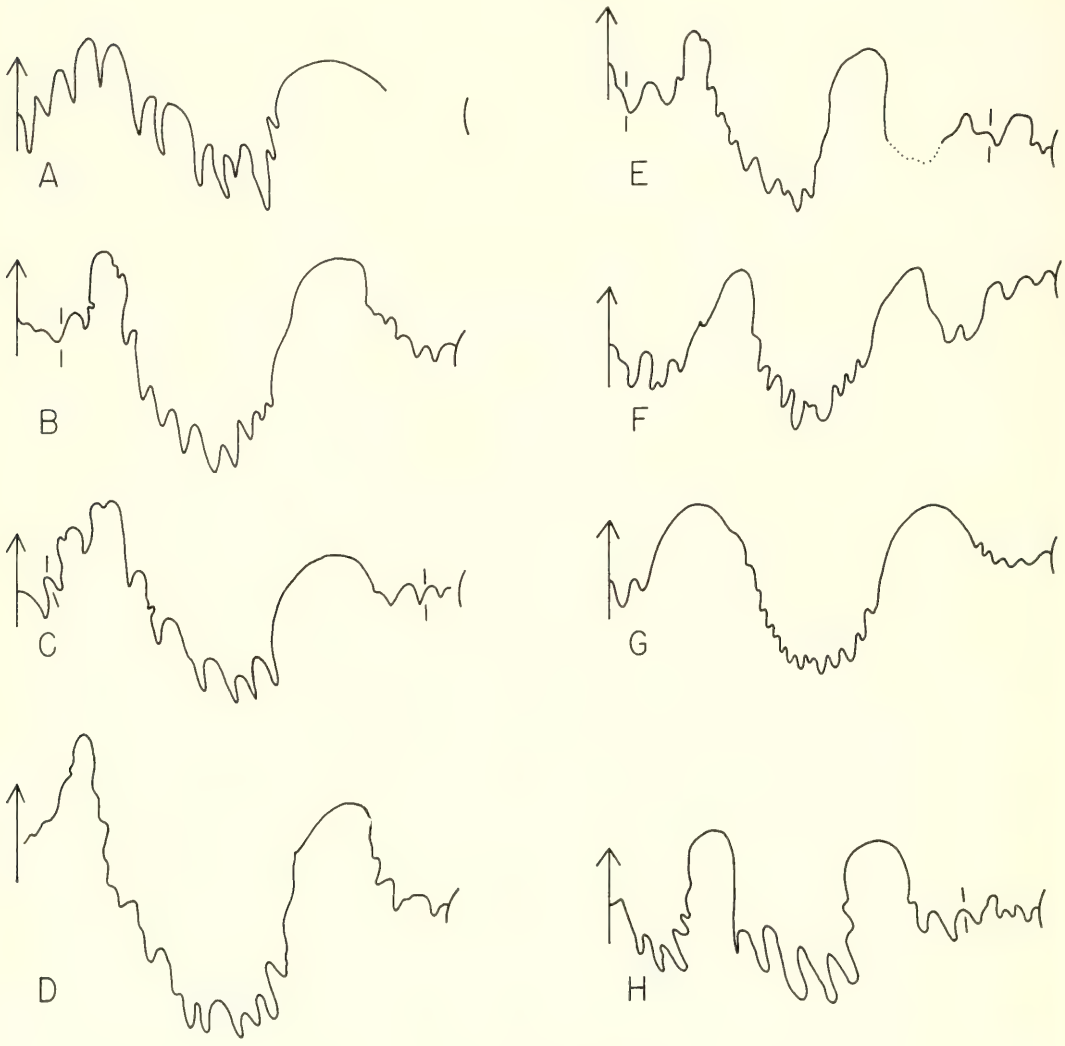


Figure 31. Diagrammatic representation of the sutures of species of *Metadagnoceras*. A, holotype of *M. pulcher* Tozer (1965a: fig. 9), from British Columbia, at a whorl height of approximately 20 mm; B, paratype of *M. tobini* n. sp., from Tobin Formation, Nevada, at a whorl height of 11 mm (MCZ 9638); C, *M.* sp., undescribed species collected by N. J. Silberling from Star Peak Formation, Nevada, at a whorl height of 22 mm; D, holotype *M. freemani* Kummel, from Nifoekoko, Timor, at a whorl height of 14 mm (BMNH C33701); E, holotype of *M. terbunicum* (Arthaber), from *Subcolumbites* fauna, Albania, at a whorl height of 18 mm; F, plesiotype *M. terbunicum*,—Renz and Renz (1948: pl. 1, fig. 7b), from *Subcolumbites* fauna of Chios at a whorl height of 14 mm (NHMB J13692); G, holotype of *Stacheites dionysi* Renz and Renz (1948: pl. 1, fig. 6b), from *Subcolumbites* fauna of Chios, at a whorl height of 17 mm (NHMB J13689); H, *M. unicum* (Kiparisova, 1961: fig. 35), from late Scythian horizon, Primorye Region, Siberia, at a whorl height of 19 mm.

the narrowly rounded venter. Its suture (Fig. 31H) is likewise quite different.

Occurrence. Russki Ostrov, Cape Schmidt, Primorye Region, from concretions in a dark siltstone together with *Columbites parisianus*. This horizon is probably equivalent to the *Columbites* Zone of southeast Idaho.

Metadagnoceras freemani Kummel
Plate 24, figures 1, 2; Text-figure 31

Metadagnoceras freemani Kummel, 1968a: 11, pl. 1, figs. 12, 13.

This species is proposed for the specimen from Timor mentioned by Spath (1934: 269, footnote) as "an isolated example of a new species from Timor . . . which is very close to *Dagnoceras terbunicum.*" The specimen measures 47.8 mm in diameter, 14.7 mm for the width of the last whorl, 21.7 mm for the height of the last whorl, and 10.4 mm for the diameter of the umbilicus. The conch is compressed with a low, arched venter and rounded ventral and umbilical shoulders. The suture (Fig. 31D) has a very large first lateral lobe with denticulations extending all along the ventral side to a narrow irregular first lateral saddle. There is a small denticulated second lateral lobe on the umbilical shoulder and wall.

This species does not resemble *Dagnoceras terbunicum* in conch shape; the differences are centered mainly in the character of the venter. In the suture the first lateral saddle and the first lateral lobe of the two species are quite similar (Figs. 31D–F) but the remainder of the suture is quite different. In general conch morphology *Metadagnoceras freemani* is quite similar to the type species, *M. pulcher* Tozer. The sutures are similar in basic plan but differ in significant details. The suture of *M. tobini* n. sp. is very nearly identical to that of *M. freemani,* but in the Nevada species the whorls are of quite different proportions and the conch much more evolute.

Occurrence. Nifoekoko, Timor, from bed with manganese coated fossils, including *Albanites, Prohungarites,* etc.

Repository. BMNH C33701, holotype.

Metadagnoceras terbunicum (Arthaber)
Plate 16, figures 7, 8; Plate 18, figures 9, 10; Text-figure 31

Dagnoceras terbunicum Arthaber, 1911: 242, pl. 21(5), figs. 10a–c; Diener, 1915: 115; Spath, 1934: 269; Renz and Renz, 1947: 60; Renz and Renz, 1948: 51, pl. 1, figs. 7–7b.

Meekoceras radiosum,—Arthaber (non Waagen) 1911: 246, pl. 21(5), fig. 14; Diener, 1915: 194.

Dagnoceras aff. *terbunico,*—C. Renz, 1928: 155.

Dagnoceras nopcsanum Arthaber var. *involuta* Renz and Renz, 1947: 60; Renz and Renz, 1948: 52, pl. 1, figs. 5–5a.

Stacheites dionysi Renz and Renz, 1947: 60, 75; Renz and Renz, 1948: 50, pl. 1, figs. 6–6b, 8–8b.

When Arthaber proposed his genus *Dagnoceras,* he included within it a heterogeneous group of species. One of these was *D. terbunicum,* characterized by a flat venter and angular ventral shoulders, which is in striking contrast to the rounded venter of the more typical species. Arthaber (1911: 240) recognized the similarity of his new generic group to *Stacheites* but was uncertain of the character of the venter of Kittl's *S. prionoides.* My own examination of *S. prionoides* clearly establishes that Kittl's type specimen has a slightly sulcate venter with angular ventral shoulders. The basic morphological features of the conch of *Dagnoceras terbunicum* do suggest, at first, the possibility of this species being a more inflated representative of *Stacheites.* The basic plan of the suture, however, is more like that found in *Metadagnoceras* than that found in *Stacheites.* Arthaber's (1911: pl. 21(5), fig. 10c) representation of the suture is misleading. A new drawing of the suture from this type specimen is shown here on Figure 31E. There is a large first lateral lobe, with prominent denticulations on the base of the lobe and extending up on the ventral side of the lobe to a narrow, irregular first lateral saddle. There is a small second lateral lobe above the umbilical shoulder that apparently has a few denticulations which are, however, indistinct because of excessive grinding; this is followed over the umbilical shoulder and wall by an irregular series of large denticulations. The character of the first lateral saddle and first lateral lobe is very much like that of the suture of *M. tobini, M.*

freemani, and the specimen from Nevada collected by N. J. Silberling from the base of the Star Peak Group, Humboldt Range, Nevada (Fig. 31C). It differs from these species in the greater elaboration and length of the remainder of the suture. The measurements of the holotype of *D. terbunicum* are: Diameter 43.0?, Width 12.0?, Height 21.8, Umbilicus 7.8 mm (the second specimen of this species mentioned by Arthaber is not in the collection of the Paleontological Institute, Vienna, and is presumed lost).

With some misgivings I include in *M. terbunicum, Meekoceras radiosum,*—Arthaber (non Waagen). This species has the same general shell form as *M. terbunicum* (compare Pl. 16, figs. 7, 8 and Pl. 18, figs. 9, 10) except for being more involute. The dimensions of this specimen are: Diameter 45.0?, Width 13.0?, Height 24.0?, Umbilicus 3.6? mm. The suture had been exposed by grinding and the pattern reproduced by Arthaber is not at all a correct representation. One can never be absolutely sure in cases like this but it appears that the suture is actually like that of the holotype of *M. terbunicum.* Thus on the basis of conch form and probable nature of the suture, this species is considered a synonym of *M. terbunicum.*

In the fauna from Chios, the Renzes (1948: 51) record one specimen as being conspecific with *D. terbunicum* Arthaber. The measurements of this specimen (Renz and Renz, 1948: pl. 1, figs. 7–7b) are as follows:

	D	W	H	U	W/D	H/D	U/D
NHMB J13692	42.0	14.2	20.3	8.3	33.8	48.3	19.8

In addition, the Renzes assigned another specimen to *D. nopcsanum* Arthaber var. *involuta* Renz and Renz (1948: 52, pl. 1, figs. 5–5a). The measurements of this species are as follows:

	D	W	H	U	W/D	H/D	U/D
NHMB J13694	28.8	10.7	13.7?	7.2	37.2	47.6?	25.0

The Albanian specimens of *D. nopcsanum* have rounded venters, the Chios specimen has a truncate, flattened venter and is merely a smaller specimen of *terbunicum.*

The Chios collection contained two specimens which the Renzes assigned to a new species of *Stacheites*—*S. dionysi.* The measurements of these two specimens are as follows:

	D	W	H	U	W/D	H/D	U/D
NHMB J13689 (Renz and Renz, 1948: pl. 1, fig. 6)	34.8	11.4	16.4	8.1	32.8	47.1	23.3
NHMB J13690 (Renz and Renz, 1948: pl. 1, fig. 8)	45.8	?	21.2	10.4	?	46.3	22.7

The conch form of *S. dionysi* is identical to that of *Metadagnoceras terbunicum*; the only difference between these forms is in the slightly greater individualization of the second lateral lobe (Fig. 31G), a difference I can hardly consider of specific significance and surely not of generic rank. Preparation of the suture in these specimens preserved in hard red limestone is very difficult, and is generally done by acid etching or grinding. Also, with only four specimens assigned to these three different species (and two genera), it is hardly justifiable to put such importance on minor differences in the suture. All three of the species are considered to be conspecific with *Metadagnoceras terbunicum* (Arthaber).

The Albanian and Chios specimens assigned to *terbunicum* have flattened venters. Silberling (personal communication) has a specimen from the Star Peak Formation, Nevada, that also has a flattened venter. This specimen is an incomplete phragmocone of approximately 44 mm in diameter. The other species of *Metadagnoceras* have low, arched venters to more highly vaulted venters. Considering the state and nature of preservation of the Albanian and Chios specimens assigned here to *terbunicum,* I believe they are all incomplete and immature specimens. It is, of course, uncertain as to what the character of the venter is like on a mature individual. As it is now interpreted, in

conch form this species is convergent to *Stacheites* but differs significantly in its suture.

Occurrence. *Subcolumbites* fauna of Albania and Chios.

Repository. Arthaber's (1911) figured type (pl. 21(5), fig. 10; Pl. 16, figs. 7, 8 of this report) is in the Paleontological Institute, University of Vienna. A second specimen indicated by Arthaber (1911: 242) is apparently lost. The Chios specimens are in the Natural History Museum, Basel, and are as follows: holotype *Dagnoceras nopcsanum* var. *involuta* Renz and Renz (1948: pl. 1, fig. 5) NHMB J13694; unfigured specimen NHMB J13833; holotype *Stacheites dionysi* Renz and Renz (1948: pl. 1, fig. 6) NHMB J13689; paratype (pl. 1, fig. 8) NHMB J13690; unfigured paratypes NHMB J13691; plesiotype *Dagnoceras terbunicum* (pl. 1, fig. 7) NHMB J13692; unfigured specimens NHMB J13693.

Genus *Balkanites* Ganev, 1966
Type species, *Balkanites tabulatus* Ganev, 1966

Conch compressed with flat lateral areas and broad flat venter. Ventral shoulders weakly rounded. Umbilicus small, about 20 percent the diameter of the conch. Umbilical wall nearly vertical, umbilical shoulders weakly rounded. Conch smooth with no ornamentation. Suture goniatitic consisting of a single large, smooth, lateral lobe with indication of the beginning of a second lobe at the umbilical shoulder. Ganev did not include a drawing of the suture in his report but he kindly sent me a photo of the specimen, plus a plaster cast which clearly shows the suture.

This is indeed a unique Scythian ammonoid and is an addition to the fairly large number of endemic genera which characterize the Werfen fauna. Ganev allied his new genus to *Dagnoceras* primarily on the basis of the single large lateral lobe. In this relationship I concur as being the most logical on the basis of the data available. In *Dagnoceras* the venter is rounded and the lobe denticulated.

Balkanites tabulatus Ganev

Balkanites tabulatus Ganev, 1966: 24, pl. 2, figs. 1a–d.

Discussion of this species is given above.

Occurrence. Campil Member of Werfen Formation, perhaps as exotic blocks, Luda-Kamčija region of eastern Bulgaria.

Repository. Holotype (and only specimen) in Geological Institute of the Bulgarian Academy of Science; plaster cast in MCZ.

Genus *Nordophiceras* Popov, 1961
Type species, *Ceratites euomphalus* Keyserling, 1845

Nordophiceras euomphalus (Keyserling)
Plate 47, figures 6–8; Text-figure 32

Ceratites euomphalus Keyserling, 1845: 171, pl. 3, figs. 7–9; Middendorff, 1860: 248, pl. 3, figs. 7–9; Eichwald, 1868: 1039.

Meekoceras euomphalum,—Mojsisovics, 1882: 214; Waagen, 1895: 239, 246; Diener, 1915: 191.

Xenodiscus euomphalus,—Mojsisovics, 1886: 76, pl. 11, fig. 7.

Nordophiceras euomphalus,—Popov, 1961: 39.

Xenodiscus karpinskii Mojsisovics, 1886: 75, pl. 11, fig. 13.

Meekoceras (Gyronites) karpinskii,—Diener, 1915: 196.

Nordophiceras karpinskii,—Popov, 1961: 41, pl. 25, fig. 6; Vozin and Tikhomirova, 1964: 50, pl. 27, fig. 2.

Nordophiceras contratius Popov, 1962a: 177.

Meekoceras contrarius Popov, 1962a: 185, pl. 3, fig. 7, text-fig. 8.

Meekoceras? contrarium,—Vozin and Tikhomirova, 1964: 55, pl. 30, fig. 3, text-fig. 9a.

Popov (1961) selected *Xenodiscus karpinskii* Mojsisovics (1886: 75, pl. 11, fig. 13) as the type species of his genus *Nordophiceras.* At the same time he included within that genus *Ceratites euomphalus* Keyserling (1845: 171, pl. 3, figs. 7–9). The latter species differs from *X. karpinskii* in having a slightly more inflated whorl section. The author has available four topotype specimens of *Nordophiceras*

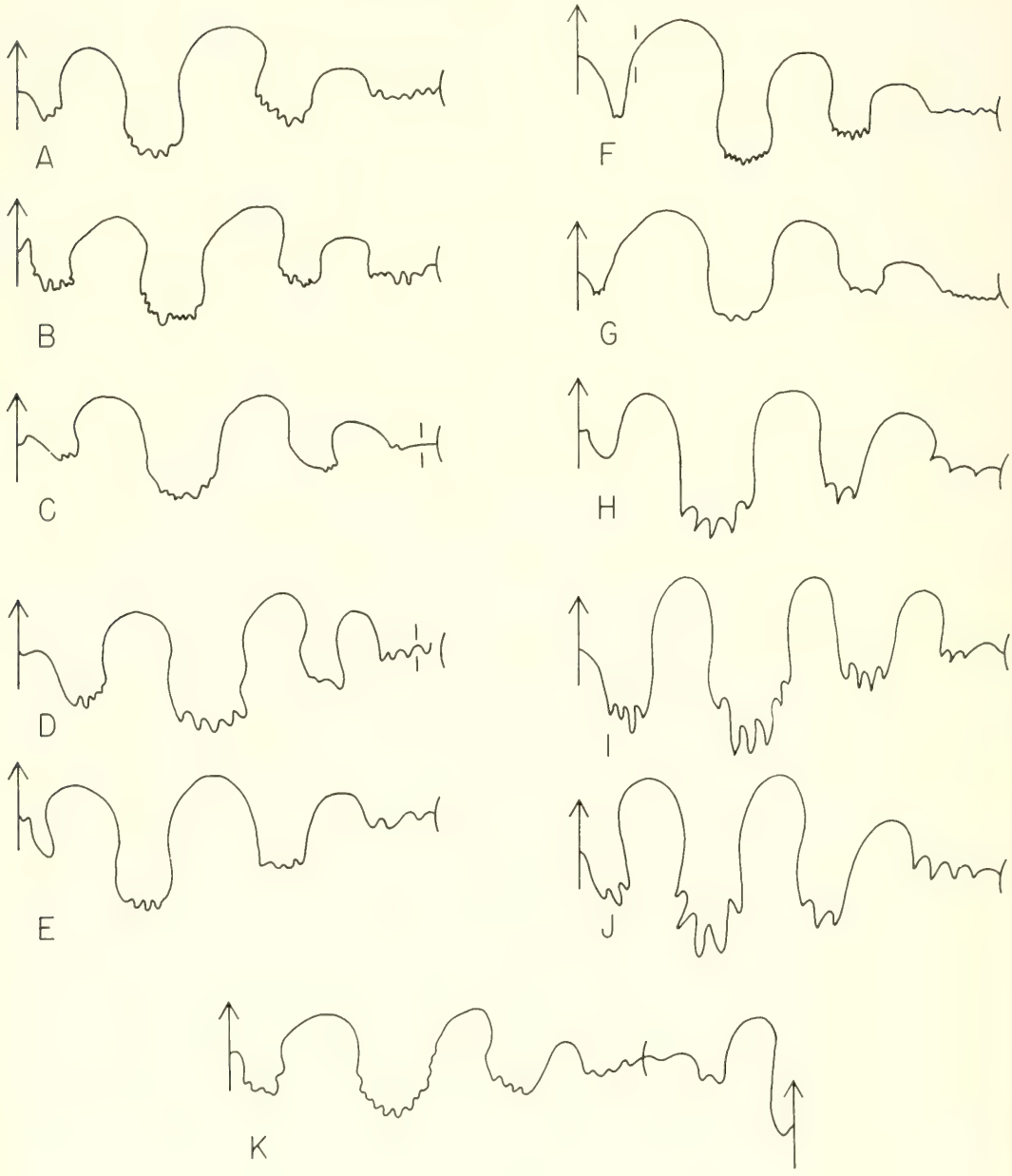


Figure 32. Diagrammatic representation of the suture of: A–C, *Nordophiceras evomphalus* (Mojsisovics), from *Dieneroceras* Zone, northern Siberia; A, topotype,—Popov (1961: 39, fig. 6e), at a whorl height of 8 mm; B, topotype (MCZ 8670a), at a diameter of 50 mm; C, topotype (MCZ 8670b), at a diameter of 26 mm; D, holotype *Nordophiceras contrarius* (Popov 1962a: fig. 8), *Dieneroceras* Zone, northern Siberia, at a whorl height of 20 mm; E, holotype *Nordophiceras alexeevae* Popov (1961: 39, fig. 6c), from *Dieneroceras* Zone, eastern Taymyr, Siberia, at a whorl height of 15 mm; F, *Nordophiceras jacksoni* (Hyatt and Smith), from *Columbites* fauna, Montpelier Canyon, southeast Idaho (MCZ 9572), at a diameter of 36 mm; G, paratype of *Prionolobus jacksoni* Hyatt and Smith (1905: pl. 62, fig. 16), from *Columbites* fauna, Paris Canyon, southeast Idaho, at a diameter of 45 mm (USNM 75292c); H, paratype *Meekoceras* (*Submeekoceras*) *compressum* Chao (1959: fig. 46a), from *Subcolumbites* fauna, Kwangsi, China, at a whorl height of 15 mm; I, holotype *Meekoceras* (*Submeekoceras*)

karpinskii identified by Dr. Popov. Examination of these specimens and of the illustrations in Mojsisovics (1886: pl. 11, fig. 7) clearly shows that these two so-called species cannot be distinguished. The combining of these two species thus makes *euomphalus* the type species of *Nordophiceras*.

Two of the Siberian topotypes in the collections of the Museum of Comparative Zoology are illustrated here on Plate 47, figures 6–8. The conch is moderately involute, compressed, with a rounded venter. The flanks are broadly convex and the umbilical shoulders rounded. The suture consists of two lateral lobes and a serrated lobe on the umbilical shoulder and wall. The sutures of two of the topotypes in the collection and that reproduced by Popov (1961: fig. 6e) are shown on Figure 32A–C. The conch is smooth except for sinuous growth lines.

Associated with this species in the Olenek fauna is a closely related species, *N. alexeevae* Popov, which differs in the presence of closely spaced fine, prosiradiate ribs on the inner whorls and more widely spaced, thin ribs on the outer whorls. In nearly all other aspects these two species are identical. A much closer relationship exists with *Nordophiceras jacksoni* (Hyatt and Smith) from the *Columbites* fauna of southeastern Idaho. The basic plan of the smooth conch and the suture is remarkably similar. The Idaho fauna has yielded a fairly large number of specimens which gives some appreciation of the variations in conch proportions (Fig. 33); this kind of data is lacking for the Siberian species described here. It is very possible that study of a large collection of the Siberian *N. euomphalus* could establish that *N. jacksoni* is a synonym; for the moment at least it seems best to keep the forms separate. It is because of this very close relationship with *N. jacksoni* that I believe *Meekoceras contrarius* is a synonym of *N. euomphalus*. The main difference in these species lies in the degree of involution. However, the difference in umbilical diameters lies well within the variation of this parameter in the populations of *N. jacksoni* from southeast Idaho. The other species of *Nordophiceras* in the *Columbites* fauna of Idaho are ornamented forms more related to *N. alexeevae*.

This species is also quite similar to *Nordophiceras planorbis* (Waagen) (Kummel, 1966: 397) from the Salt Range of West Pakistan from an upper Scythian horizon. The basic architecture of the conch is most similar; however, the Salt Range species is known from very few and generally poorly preserved specimens.

Occurrence. Mojsisovics' specimens are from the region of the mouth of the Olenek River, those described by Popov (1961) are from his *Dieneroceras* Zone in eastern Taymyr, Chernokhrebetnaya River.

Repository. Topotype specimens MCZ 9655 (Pl. 47, fig. 6), MCZ 8680 (Pl. 47, figs. 7, 8), MCZ 6107, 9656.

Nordophiceras alexeevae Popov
Text-figure 32

Nordophiceras alexeevae Popov, 1961: 39, pl. 25, fig. 7.

Nordophiceras olenekensis Popov, 1961: 40, pl. 12, fig. 8.

This species from northern Siberia is of particular interest because it is another form closely related to a species in the *Columbites* fauna of southeastern Idaho. In fact, because the Idaho fauna has yielded

←

lolouense Chao (1959: fig. 45d), from *Subcolumbites* fauna, Kwangsi, China, at a whorl height of 12 mm; J, holotype *Meekoceras* (*Submeekoceras*) *longiseptatum* Chao (1959: fig. 46c), from *Subcolumbites* fauna of Kwangsi, at a whorl height of 22 mm; K, holotype *Nordophiceras olenekensis* Popov (1961:40, fig. 6d), from *Dieneroceras* Zone, northern Siberia, at a whorl height of 12 mm.

a fairly large number of specimens, the data on that species (*N. pilatum*) have aided greatly in the interpretation of this Siberian species. It should be pointed out that Popov had available only one specimen of *N. alexeevae* and six specimens of *N. olenekensis*.

This species is essentially of the same conch morphology, that is in compression, involution, etc., as the associated *N. euomphalus*, except that on the inner whorls there are fine, closely spaced prosiradiate ribs which on the outer whorls are more widely spaced. The two species of Popov differ only in the degree of this ornamentation. *Nordophiceras pilatum* from the *Columbites* fauna of southeastern Idaho has a similar pattern of ornamentation. The large number of specimens in the Idaho collection clearly show a broad range of variation in the degree of intensity of ornamentation. The suture is illustrated on Figure 32E, K.

Occurrence. *Dieneroceras* Zone of Popov (1961), eastern Taymyr and the delta of the Lena River, northern Siberia.

Nordophiceras pseudosimplex n. sp.

Arctoceras simplex,—Popov (non Mojsisovics), 1961: 67, pl. 18, fig. 1; Vozin and Tikhomirova, 1964: 55, pl. 29, fig. 1.

Arctoceras simplex Mojsisovics (1886) was established for specimens which are the inner, juvenile whorls of *Arctoceras blomstrandi* (Lindström), and is of mid-Scythian *Owenites* Zone age (Kummel, 1961). The specimen Popov (1961) assigned to *Arctoceras simplex* is not at all comparable. Popov's specimen is more evolute, has flattened, more or less parallel, lateral areas. Popov (1961) states his specimen has smooth inner whorls but that one specimen had widely spaced radial ribs which disappeared on the body chamber. The ribs are not apparent on Popov's illustration. The suture is said to be ceratitic but this is not borne out by the published text-figure.

Needless to say that much more data are needed, but we can be sure that this specimen is not conspecific with *Arctoceras simplex* but rather is allied to such forms as *Nordophiceras euomphalus* from the underlying *Dieneroceras* Zone of Popov. It is, likewise, quite similar to *Nordophiceras planorbis* (Waagen) from the Narmia Member of the Mianwali Formation in the Salt Range.

Occurrence. *Olenekites* Zone in basin of Olenek River, northern Siberia.

Nordophiceras planorbis (Waagen)

Lecanites planorbis Waagen, 1895: 278, pl. 39, fig. 3.
Meekoceras (Gyronites) planorbis,—Diener, 1915: 197.
Nordophiceras planorbis,—Kummel, 1966: 397, pl. 4, figs. 1–3.

New illustrations and descriptions of the type specimens and two topotype specimens have been published by Kummel (1966). This is the only record of *Nordophiceras* for the Tethyan region.

Occurrence. Narmia Member, Mianwali Formation, Chhidru Nala, Salt Range, West Pakistan.

Repository. Holotype GSI 7226; topotypes MCZ 9611, 9612.

Nordophiceras jacksoni (Hyatt and Smith) Plate 47, figures 1–5; Plate 48, figures 1–4; Text-figures 32, 33

Prionolobus jacksoni Hyatt and Smith, 1905: 151, pl. 151, figs. 11–21; Krafft and Diener, 1909: 40, 41.
Meekoceras jacksoni,—Diener, 1915: 192.
Ophiceras jacksoni,—Smith, 1932: 49, pl. 62, figs. 11–21.

This species is abundantly represented in the *Columbites* beds exposed around the north end of Bear Lake, southeastern Idaho. The conch is smooth, evolute, compressed, with a rounded venter. The measurements of 48 specimens are given on Table 41 and plotted on Figure 33. These data show that there is only a moderate amount of variation in evolution

TABLE 41. MEASUREMENTS OF *NORDOPHICERAS JACKSONI* (HYATT AND SMITH) FROM *COLUMBITES* FAUNA, BEAR LAKE REGION, SOUTHEASTERN IDAHO.

	D	W	H	U	W/D	H/D	U/D		D	W	H	U	W/D	H/D	U/D
1.	62.0	14.2	20.7	25.1	22.9	33.4	40.5	25.	25.6	7.1	11.5	7.0	27.7	44.9	27.3
2.	61.0?	14.4	21.8	23.3	23.6?	35.7?	38.2?	26.	25.3	7.2	9.6	9.0	28.5	37.9	35.6
3.	55.7	12.2	21.0	20.0	21.9	37.7	35.9	27.	25.2	7.2	11.1	6.8	28.5	44.0	26.9
4.	50.4	10.8	20.4	15.3	21.4	40.5	30.4	28.	24.6	6.5	10.7	6.2	26.4	43.5	25.2
5.	47.0	11.0	18.4	15.0	23.4	39.1	31.9	29.	24.6	6.3	11.5	5.4	25.6	46.7	21.9
6.	45.3	11.4	18.3	13.5	25.1	40.4	29.8	30.	24.0	7.2	10.5	6.4	30.0	43.8	26.7
7.	44.4	11.5	16.2	16.7	25.9	36.5	37.6	31.	21.1	6.5	8.7	6.6	30.8	41.2	31.3
8.	44.2	10.6	17.5	12.5	23.9	39.6	28.3	32.	20.1	6.0	8.4	6.5	29.9	41.8	32.3
9.	43.0	9.7	18.2	11.0	22.6	42.3	25.6	33.	20.0	5.4	8.2	5.3	27.0	41.0	26.5
10.	39.1	9.6	15.4	12.5	24.6	39.4	31.9	34.	19.3	5.7	8.2	5.7	29.5	42.5	29.5
11.	36.2	8.5	14.4	11.9	23.5	39.8	32.9	35.	19.2	5.7	8.1	5.7	39.7	42.2	29.7
12.	33.8	8.2	14.7	9.0	24.3	43.5	26.6	36.	18.9	6.5	7.4	5.8	34.4	39.2	30.7
13.	32.6	?	13.0	9.9	?	39.9	30.4	37.	18.2	5.1	7.0	5.9	28.0	38.5	32.4
14.	32.5	8.4	13.7	9.3	25.8	42.2	28.6	38.	18.1	5.8	7.3	6.1	32.0	40.3	33.7
15.	31.0	8.3	13.3	8.7	26.8	42.9	28.1	39.	18.0	6.0	7.7	6.1	33.3	42.8	33.9
16.	31.0	8.5	12.4	10.2	27.4	40.0	32.9	40.	17.5	6.0	7.4	5.7	34.3	42.2	32.6
17.	29.0	7.2	10.5	10.7	24.8	36.2	36.9	41.	16.7	5.3	6.4	5.7	31.7	38.3	34.1
18.	28.4	7.6	11.2	9.1	26.7	39.4	32.0	42.	16.3	5.7	6.4	5.1	34.9	39.3	31.3
19.	28.0	7.0?	12.3	8.1	25.0?	43.9	28.9	43.	15.8	5.0	6.3	5.3	31.6	39.9	33.5
20.	27.5	7.3	11.8	7.6	26.5	42.9	27.6	44.	13.7	4.8	5.4	4.7	35.0	39.4	34.3
21.	27.2	7.0	11.2	9.3	25.7	41.2	34.2	45.	11.5	4.3	5.0	4.0	37.4	43.5	34.8
22.	26.2	7.2	11.4	7.0	27.5	43.5	26.7	46.	11.3	4.2	4.4	3.7	37.2	38.9	32.7
23.	26.0	7.5	10.8	7.8	28.8	41.5	30.0	47.	10.8	4.3	4.3	3.6	39.8	39.8	33.3
24.	26.0	6.8	9.8	9.2	26.1	37.7	35.4	48.	10.1	4.4	3.9	3.2	43.6	38.6	31.7

1. Plesiotype, MCZ 9565 (Pl. 47, fig. 2).
3. Plesiotype, MCZ 9564 (Pl. 47, fig. 1).
4. Holotype, USNM 75292a (Pl. 48, figs. 3, 4).
8. Paratype, USNM 75292c (Pl. 48, figs. 1, 2).
15. Plesiotype, MCZ 9567 (Pl. 47, fig. 4).
24. Plesiotype, MCZ 9568 (Pl. 47, fig. 5).
29. Paratype, USNM 75292d (Smith, 1932: pl. 62, figs. 17, 18).
45. Plesiotype, MCZ 9566 (Pl. 47, fig. 3).

All other specimens are from the *Columbites* fauna, Thaynes Formation at Montpelier Canyon and Hot Springs, southeastern Idaho.

or in the dimensions of the whorls. There is a tendency toward greater opening of the umbilicus with growth. Two of the largest specimens of this species are illustrated on Plate 47, figures 1, 2; both of these specimens show larger relative diameters of the umbilicus than more juvenile forms.

The suture is shown in Figure 32F, G, and consists of two denticulated lateral lobes and an auxiliary lobe on the umbilical shoulder and wall that is generally irregularly straight and denticulated. The smooth conch bears only fine growth lines.

Nordophiceras jacksoni is very similar to *Nordophiceras euomphalus* (Keyserling) from northern Siberia. The similarity is so close that I consider it possible these two species may be conspecific. The Siberian species is known from very few specimens, and no data are available on the variation within those populations. For the moment it seems best to keep the two species separate.

Nordophiceras jacksoni and *N. euomphalus* are the smooth species of this genus; in contrast to these two species there are two other described species—*N. alexeevae* and *N. pilatum*—which are very similar in general conch morphology but bear some ornamentation in the form of ribs.

Occurrence. Columbites fauna, Thaynes Formation, at Paris Canyon, Montpelier

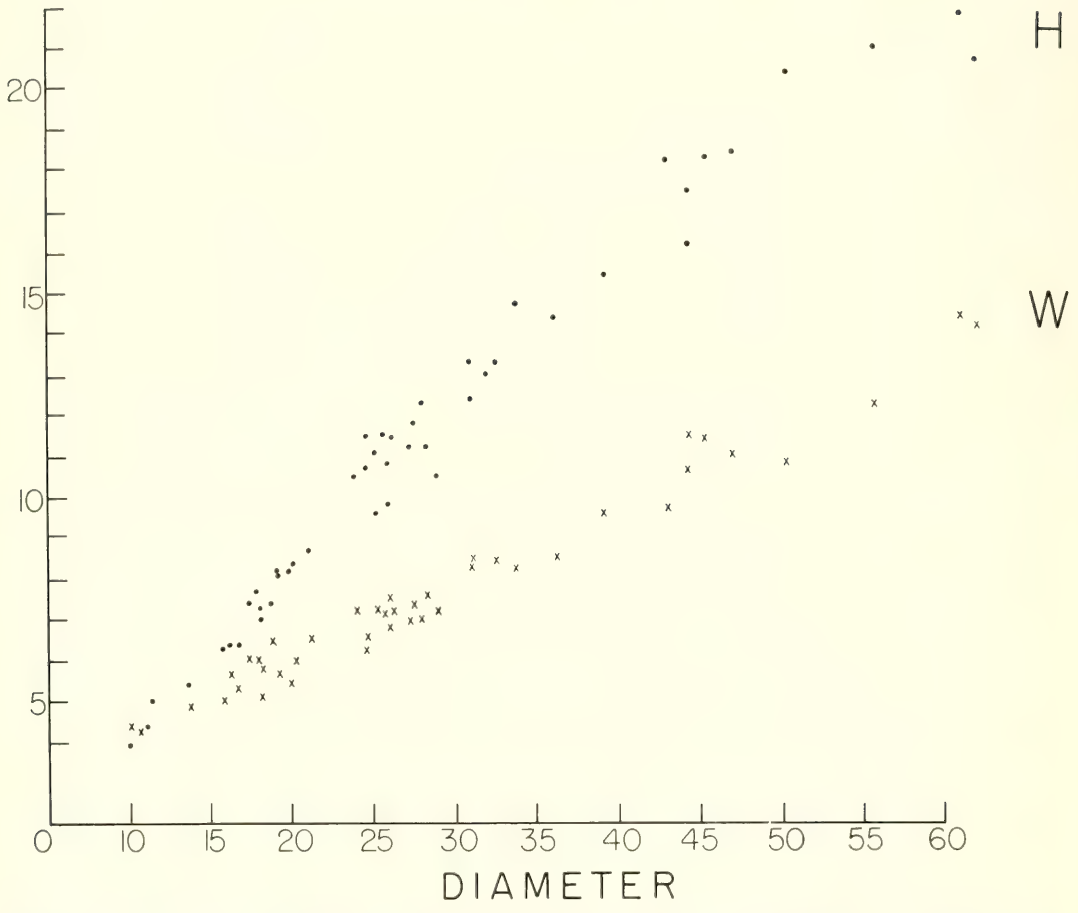


Figure 33. Variation in whorl height (H) and whorl width (W) of *Nordophiceras jacksoni* (Hyatt and Smith), from *Columbites* fauna, Bear Lake region, southeast Idaho. The data on this graph are from Table 41.

Canyon, and Hot Springs, southeastern Idaho.

Repository. Holotype, USNM 75292a (Pl. 48, figs. 3, 4); paratypes, USNM 75292b (Smith, 1932: pl. 62, fig. 14), USNM 75292c (Pl. 48, figs. 1, 2), USNM 75282d (Smith, 1932: pl. 62, figs. 17, 18), USNM 75292e (Smith, 1932: pl. 62, figs. 19–21); plesiotypes, MCZ 9564 (Pl. 47, fig. 1), MCZ 9565 (Pl. 47, fig. 2), MCZ 9566 (Pl. 47, fig. 3), MCZ 9567 (Pl. 47, fig. 4), MCZ 9568 (Pl. 47, fig. 5); suture specimen, MCZ 9572 (fig. 32F); unfigured specimens from Montpelier Canyon MCZ 9570, from Hot Springs MCZ 9571.

Nordophiceras pilatum (Hyatt and Smith) Plate 46, figures 2, 3; Plate 49, figures 1–8; Plate 50, figures 1–11; Plate 51, figures 1–5; Text-figures 34, 35

Meekoceras pilatum Hyatt and Smith, 1905: 144, pl. 63, figs. 3–9; Diener, 1915: 193; Smith, 1932: 59, pl. 63, figs. 7–13.

Meekoceras curticostatum Smith, 1932: 56, pl. 48, figs. 21–30.

Meekoceras micromphalus Smith, 1932: 58, pl. 49, figs. 5–11.

Meekoceras sanctorum Smith, 1932: pl. 49, figs. 1–4.

This is one of the more abundant species in the *Columbites* fauna of southeastern Idaho. Basically this species has an involute, compressed conch, with a rounded

venter, and bears prosiradiate ribs of varying strength. There are considerable variations in the degree of involution, inflation of the whorls, and ornamentation. The measurements of 42 specimens, including the primary types, are given on Table 42 and plotted on Figure 35.

All of Smith's (1932) collection from the *Columbites* fauna of southeastern Idaho came from one locality, namely Paris Canyon. In the description of the four species now included in *N. pilatum*, Smith (1932) made a direct comparison only between his *Meekoceras curticostatum* and *Meekoceras pilatum*; he states, "*Meekoceras curticostatum* has some resemblance to *M. pilatum*, with which it is associated, differing in the wider umbilicus, more compressed whorls, weaker and more numerous ribs." Smith considered his *Meekoceras micromphalus* to be closely related to *Meekoceras keyserlingi* Mojsisovics (now the type species of *Boreomeekoceras* Popov, 1961) from the Olenek region of Siberia. He considered his *Meekoceras sanctorum* to be closely related to *Meekoceras affine* Mojsisovics also from the Olenek region of Siberia. Even though Smith (1932) did not discuss the specific criteria upon which he separated his species of this group, it is clear that the intensity of ribbing, degree of whorl inflation, and degree of involution were important considerations. On examination of a fairly large suite of specimens it is readily apparent that the primary types of *Meekoceras sanctorum* (Pl. 49, figs. 1–3) and *Meekoceras micromphalus* (Pl. 50, figs. 7–11) are juvenile specimens. Both these specimens are characterized by rather small umbilici; examination of large mature specimens, such as the holotype of *Meekoceras curticostatum* (Pl. 50, figs. 1, 2) and the new plesiotypes (Pl. 51, figs. 1–5), clearly shows how the umbilicus increases in relative diameter with growth. This is well shown on the graph of Figure 34. The umbilical region also reflects another facet of variation and this is in the nature of the umbilical shoulder and wall. Generally, the umbilical shoulder is fairly acutely rounded with a sloping umbilical wall; at the same time, there are forms with slightly more rounded umbilical shoulders and lower, sloping umbilical walls. Among the large number of specimens before me one can recognize a continuous gradation from one type to the other.

The most conspicuous variation within this species is in the intensity of the ribbing. Typically the ribbing pattern consists of fine, prosiradiate ribs on the inner volutions that become more widely spread and more subdued with growth of the shell. In some forms the ribbing on the inner volutions is extremely faint and on the outer volutions there is nothing more than a vague bundling of the growth lines (see Pl. 49, fig. 1). On the other hand the ribbing on the inner volutions may be coarse and more widely spaced (as in the paralectotype of *N. pilatum*, Pl. 49, figs. 4–6) but on the mature volutions these become inconspicuous broad folds (as in the lectotype of *N. pilatum*, Pl. 49, figs. 7, 8). Finally, there are forms (as the specimen of Pl. 50, fig. 2) in which the ribs continue to increase in intensity throughout growth. The photographs here of the primary types and of a few additional plesiotypes illustrate the range of variation in ornamentation to be observed in the collection. Needless to say, there is complete gradation from one type to the other.

The venter is another area in which one can observe extensive variation. This may be from forms with acutely rounded venters to forms with more broadly rounded venters. Generally, the acutely rounded venters are found in the more juvenile specimens.

This species is very similar to *N. alexeevae* Popov from northern Sibera. Both these species are the ornamented nordophicerids associated in their respective faunas with smooth species, *euomphalus* in Siberia, and *jacksoni* in southeast Idaho.

The sutures are illustrated on Figure 34.

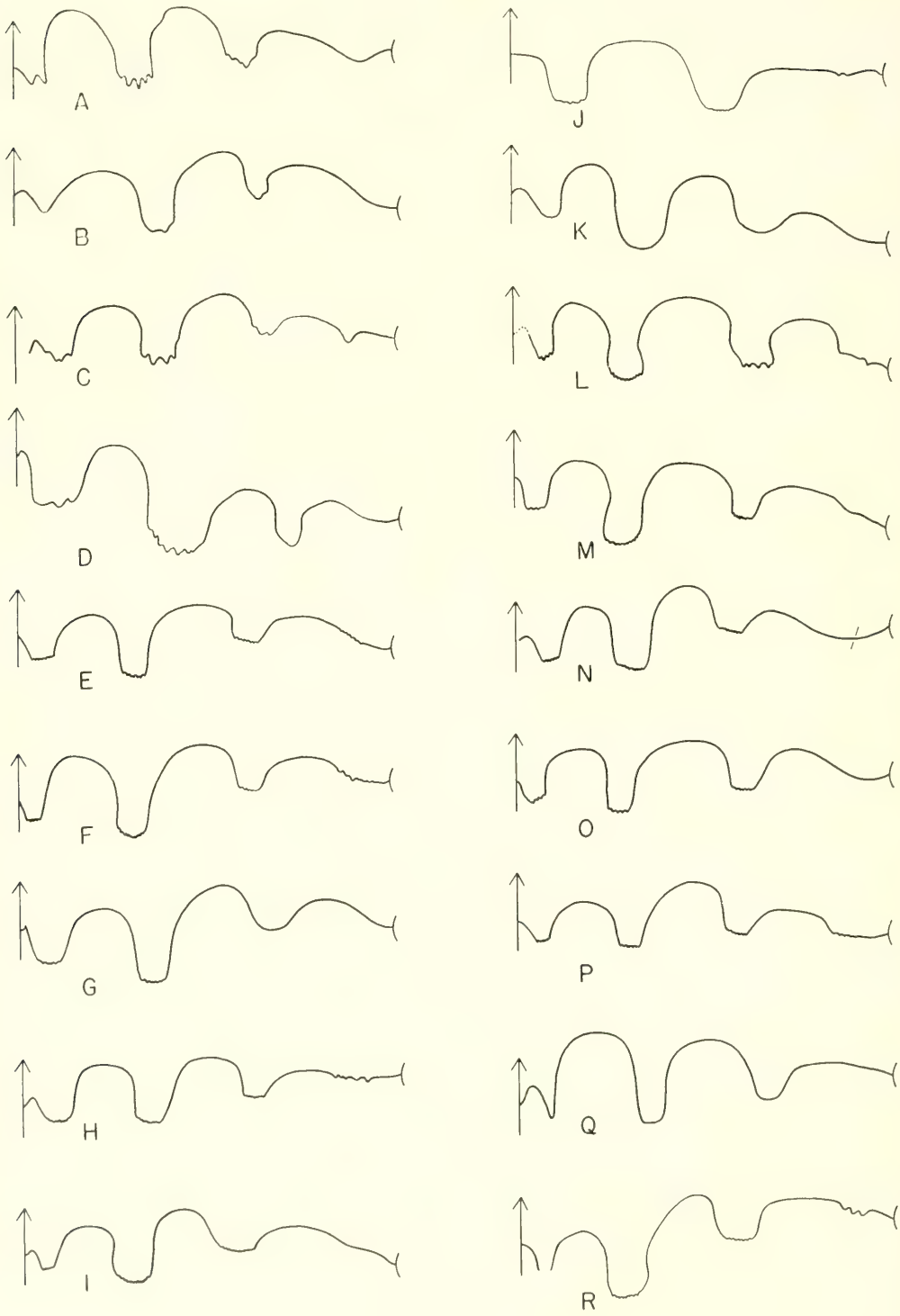

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TABLE 42. MEASUREMENTS OF *NORDOPHICERAS PILATUM* (HYATT AND SMITH) FROM THE *COLUMBITES* FAUNA AROUND BEAR LAKE, SOUTHEASTERN IDAHO.

	D	W	H	U	W/D	H/D	U/D		D	W	H	U	W/D	H/D	U/D
1.	87.0	17.8	37.2	21.4	20.5	42.8	24.6	22.	42.7	9.4	18.8	12.0	22.0	44.0	28.1
2.	78.0	15.6	33.4	18.0	20.0	42.8	23.1	23.	42.5	8.8	17.7	11.7	20.7	40.0	27.5
3.	73.7	16.0	30.5	20.6	21.7	41.4	27.9	24.	41.8	9.2	19.0	9.6	22.0	45.5	22.9
4.	72.5	13.7	29.0	21.0	18.9	40.0	28.9	25.	41.5	11.0	21.0	6.4	26.5	50.6	15.4
5.	70.2	16.0	30.2	20.0	22.8	43.0	28.5	26.	40.4	8.3	17.7	9.2	20.5	43.8	22.8
6.	68.5	13.8	28.8	19.0	20.1	42.0	27.7	27.	39.2	9.4	16.7	11.6	23.9	42.6	29.6
7.	60.0	15.8	29.0	12.3	26.3	48.3	20.5	28.	38.4	8.1	16.8	10.0	21.1	43.8	26.0
8.	57.8	12.0	22.6	16.7	20.8	39.1	28.9	29.	37.9	8.5	19.5	5.7	22.4	51.5	15.0
9.	57.4	13.2	24.8	14.2	22.9	43.2	24.7	30.	35.8	7.2	15.7	8.8	20.1	43.9	24.6
10.	57.3	11.7	26.9	11.2	20.4	46.9	19.5	31.	35.7	7.8	19.0	5.0	21.8	53.2	14.0
11.	55.0	?	22.3	16.2	?	40.5	29.5	32.	34.6	8.0	15.7	7.8	23.1	45.4	66.8
12.	54.4	9.5	23.0	15.0	17.5	42.3	27.6	33.	33.7	7.5	17.0	5.3	22.3	50.4	15.7
13.	54.4	10.8	23.7	13.0	19.9	43.6	23.9	34.	33.4	7.2	15.4	6.5	21.6	46.1	19.5
14.	53.4	10.2	21.4	16.8	19.1	40.1	31.5	35.	33.2	?	15.2	8.0	?	45.8	24.1
15.	53.1	10.8	23.5	13.7	20.3	44.2	25.8	36.	32.3	6.5	13.9	8.9	20.1	43.0	27.6
16.	52.0	11.0	22.7	13.2	21.2	22.5	25.4	37.	31.4	6.8	14.2	7.3	21.7	45.2	23.2
17.	48.7	9.2	19.8	9.0	18.9	40.7	18.5	38.	30.3	7.2	16.0	5.2	23.8	52.8	17.2
18.	48.7	10.6	21.2	13.0	21.8	43.5	26.7	39.	27.3	6.3	12.6	6.1	23.1	46.2	22.3
19.	48.6	10.2	21.4	13.7	20.9	44.0	28.2	40.	21.0	4.6	10.4	4.1	21.9	49.5	19.5
20.	46.7	9.6	21.0	10.0	20.6	44.9	21.4	41.	16.6	5.6	7.6	4.4	33.7	45.8	26.5
21.	43.3	12.1	20.7	9.4	27.9	47.8	21.7	42.	12.5	3.4	6.3	2.5	27.2	50.4	20.0

3. Holotype, *Meekoceras curticostatum* Smith (1932: pl. 48, figs. 21, 22), USNM 74990a.
5. Plesiotype, MCZ 9542 (Pl. 51, figs. 2, 3).
6. Plesiotype, MCZ 9541 (Pl. 51, fig. 5).
7. Syntype, *Meekoceras pilatum* Hyatt and Smith (1905: pl. 63, figs. 7, 8), USNM 75294a.
14. Plesiotype, MCZ 9539 (Pl. 51, fig. 1).
15. Plesiotype, MCZ 9540 (Pl. 51, fig. 4).
20. Paratype, *Meekoceras sanctorum* Smith (1932: pl. 49, figs. 3, 4), USNM 74991b.
21. Syntype, *Meekoceras pilatum* Hyatt and Smith (1932: pl. 63, figs. 10–13), USNM 75294b.
25. Holotype, *Meekoceras micromphalus* Smith (1932: pl. 49, figs. 5–8), USNM 74992a.
29. Holotype, *Meekoceras sanctorum* Smith (1932: pl. 49, figs. 1, 2), USNM 74991a.
31. Paratype, *Meekoceras curticostatum* Smith (1932: pl. 48, figs. 23, 24), USNM 74990b.
33. Plesiotype, MCZ 9544 (Pl. 46, fig. 3).
34. Plesiotype, MCZ 9543 (Pl. 46, fig. 2).
38. Paratype, *Meekoceras curticostatum* Smith (1932: pl. 48, figs. 25, 26), USNM 74990c.
40. Paratype, *Meekoceras curticostatum* Smith (1932: pl. 48, figs. 27, 28), USNM 74990d.
41. Paratype, *Meekoceras micromphalus* Smith (1932: pl. 48, figs. 9–11), USNM 74992b.
42. Paratype, *Meekoceras curticostatum* Smith (1932: pl. 48, figs. 29, 30), USNM 74990e.

All other specimens are from the *Columbites* fauna, Thaynes Formation at Hot Springs (MCZ 9546) and Montpelier Canyon (MCZ 9545), southeastern Idaho.

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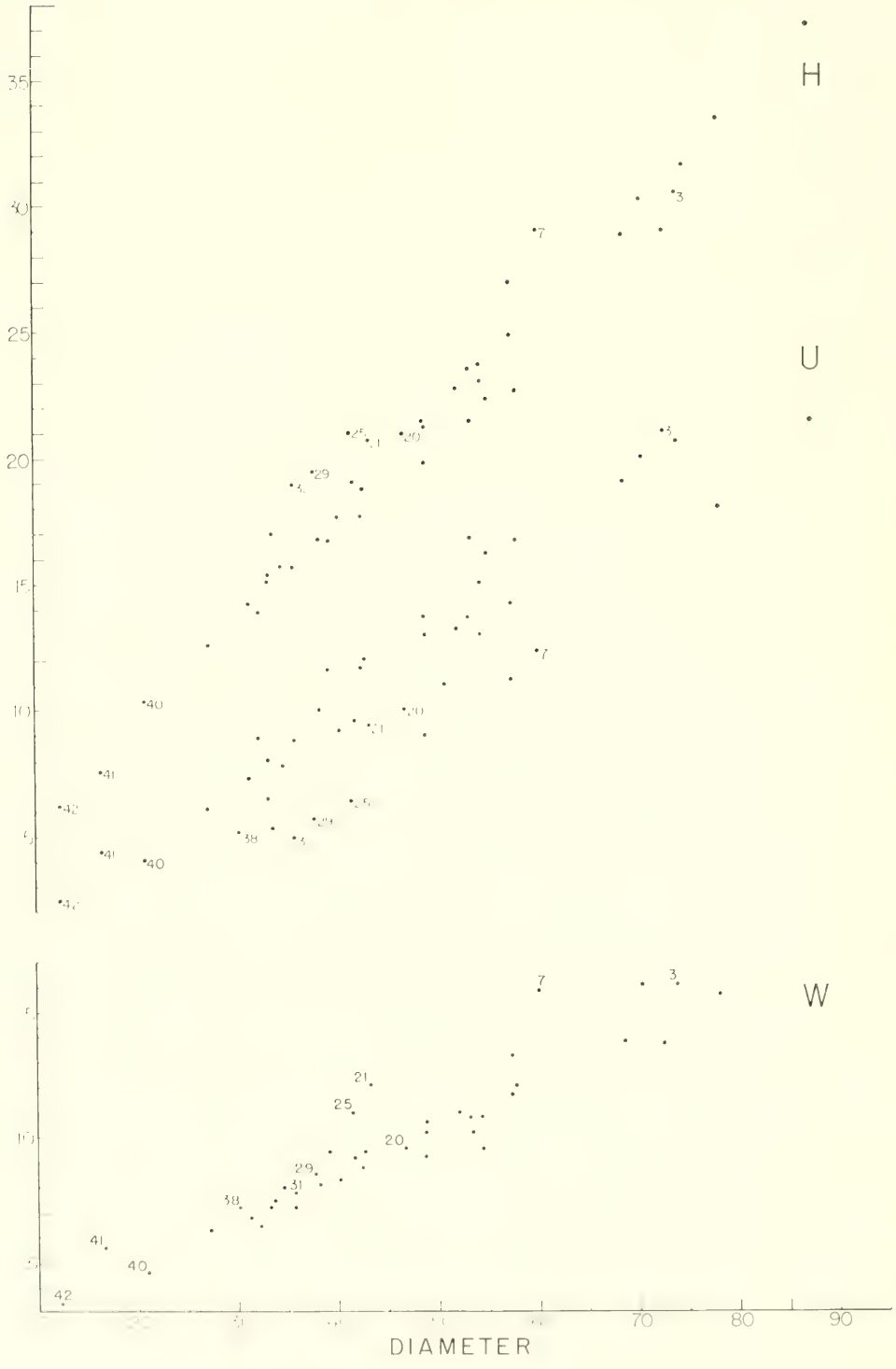
Figure 34. Diagrammatic representations of the sutures of *Nordophiceras pilatum* (Hyatt and Smith). A, from paratype of *Meekoceras micromphalus* Smith (1932: pl. 49, fig. 8), at a diameter of 17 mm (USNM 74992b); B, from paratype of *Meekoceras curticostatum* Smith (1932: pl. 48, fig. 24), at a diameter of 33 mm (USNM 74990b); C, from paratype of *Meekoceras sanctorum* Smith (1932: pl. 49, fig. 4), at a diameter of 29 mm (USNM 74991b); D, from lectotype of *Meekoceras pilatum* Hyatt and Smith (1905: pl. 63, fig. 9), at a diameter of 60 mm (USNM 75294a); E, at a diameter of 45 mm (MCZ 9573a); F, at a diameter of 31 mm (MCZ 9573b); G, at a diameter of 40 mm (MCZ 9573c); H, at a diameter of 42 mm (MCZ 9573d); I, at a diameter of 35 mm (MCZ 9573e); J, at a diameter of 45 mm (MCZ 9573f); K, at a diameter of 30 mm (MCZ 9573g); L, at a diameter of 52 mm (MCZ 9573h); M, at a diameter of 34 mm (MCZ 9573i); N, at a diameter of 40 mm (MCZ 9573j); O, at a diameter of 53 mm (MCZ 9573k); P, at a diameter of 41 mm (MCZ 95731); Q, at a diameter of 26 mm (MCZ 9573m); R, at a diameter of 45 mm (MCZ 9573n).

All specimens from *Columbites* fauna, Thaynes Formation, southeastern Idaho; specimens A–D are from Paris Canyon, H and L from Hot Springs, the remaining specimens from Montpelier Canyon. All diameters given are approximate.


H
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DIAMETER

Occurrence. *Columbites* fauna, Thaynes Formation at Paris Canyon, Hot Springs, and Montpelier Canyon, southeastern Idaho.

Repository. Lectotype, *Meekoceras pilatum* Hyatt and Smith (1905: pl. 63, figs. 7–9) USNM 75294a; paralectotype (Hyatt and Smith, 1905: pl. 63, figs. 10–13) USNM 75294b; holotype, *M. curticostatum* Smith (1932: pl. 48, figs. 21, 22) USNM 74990a; paratypes (Smith, 1932: pl. 48, figs. 23, 24) USNM 74990b, (Smith, 1932: pl. 48, figs. 25, 26) USNM 74990c, (Smith, 1932: pl. 48, figs. 27, 28) USNM 74990d, (Smith, 1932: pl. 48, figs. 29, 30) USNM 74990e; holotype *M. sanctorum* Smith (1932: pl. 49, figs. 1, 2) USNM 74991a; paratype (Smith, 1932: pl. 49, figs. 3, 4) USNM 74991b; holotype *M. micromphalus* Smith (1932: pl. 49, figs. 5–8) USNM 74992a; paratype (Smith, 1932: pl. 49, figs. 9–11) USNM 74992b; plesiotypes MCZ 9539 (Pl. 51, fig. 1), MCZ 9542 (Pl. 51, figs. 2, 3), MCZ 9540 (Pl. 51, fig. 4), MCZ 9541 (Pl. 51, fig. 5), MCZ 9543 (Pl. 46, fig. 2), MCZ 9544 (Pl. 46, fig. 3); suture specimens MCZ 9573 a–n; unfigured specimens from Montpelier Canyon MCZ 9545; unfigured specimens from Hot Springs MCZ 9546.

Nordophiceras compressum (Chao)
Text-figure 32

Meekoceras (Submeekoceras) compressum Chao, 1959: 140, 320, pl. 44, figs. 1–6, text-fig. 46a, b.
Meekoceras (Submeekoceras) lolouense Chao, 1959: 141, p. 320, pl. 10, figs. 7, 8, text-fig. 45d.
Meekoceras (Submeekoceras) longiseptatum Chao, 1959: 141, pl. 10, figs. 5, 6, text-fig. 46c.

The three species brought together here are based on specimens that come from the same horizon and locality; two of the species were based on one specimen each, the other on five specimens. Chao (1959) made no mention of the specific criteria he used to differentiate these species. I can see no significant differences between any of these species. The sutures (Figs. 32H–J) are remarkably similar.

This is a smooth form of *Nordophiceras* of the general pattern of *euomphalus*, *pseudosimplex*, and *planorbis*. There are slight differences in conch form among these species but more than anything the suture is quite distinctive and the most useful in differentiating this species.

Occurrence. Limestone block containing a *Subcolumbites* fauna in Lolou village (Chao collection 542b) Kwangsi, China.

Genus *Pseudokymatites* Spath, 1934
Type species, *Kymatites svilajanus* Kittl, 1903

Pseudokymatites svilajanus (Kittl)
Plate 62, figure 5, Text-figure 40

Kymatites svilajanus Kittl, 1903: 69, pl. 4, fig. 3; Diener, 1915: 181.
Pseudokymatites svilajanus,—Spath, 1934: 265, fig. 91; Kummel, *in* Arkell et al., 1957: L143, fig. 175, 6.

Kittl's type and only specimen of this species is incomplete, crushed, and at best of only fair preservation. It measures 63.5 mm in diameter, 13.0? mm for the width of the adoral whorl, 29.4 mm for the height, and the umbilicus is 12.3 mm in diameter. Spath (1934: 265) created a new genus for this species in his belief that it was probably a "smooth meekoceratid" with smooth lateral lobes. The goniatitic nature of the lobes, however, is not at all certain. The specimen is weathered and the smooth nature of the lobes could well be the result of this. It is not possible to settle this question on the basis of the single specimen available. Speculations of the genetic relations of this form are pointless until the

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Figure 35. Variation in whorl height (H), whorl width (W), and umbilical diameter (U) of *Nordophiceras pilatum* (Hyatt and Smith), from *Columbites* fauna, Bear Lake region, southeast Idaho. The data on this graph are from Table 42.

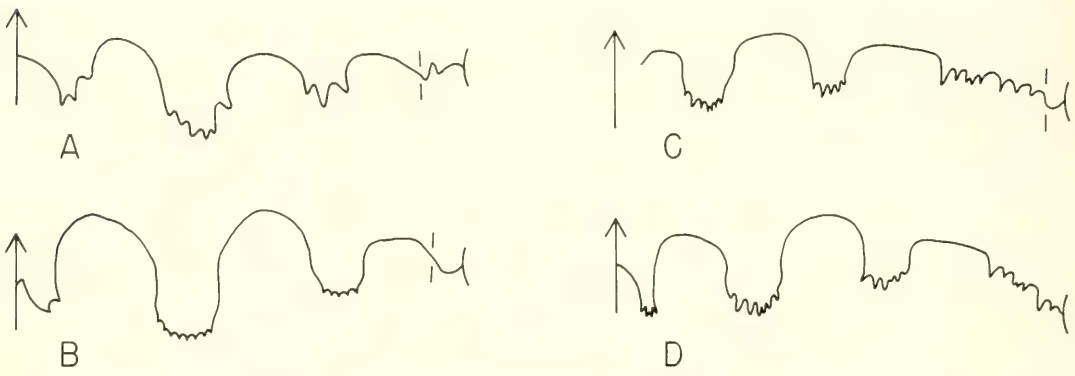

Figure 36. Diagrammatic representation of the suture of: A, *Arctomeekoceras rotundatum*,—Popov (1962a: fig. 9), from *Olenekites* Zone, northern Siberia, at a whorl height of 20 mm; B, *Arctomeekoceras* sp. indet. Kummel (1966: fig. 22E), from Narmia Member of Mianwali Formation, Surghar Range, West Pakistan, at a whorl height of 9 mm; C, D, two sutures of topotype specimen of *Boreomeekoceras keyserlingi* (Mojsisovics) from *Olenekites* Zone, northern Siberia, C, at a whorl height of 26.5 mm, D, at a whorl height of 15 mm (MCZ 8684).

basic morphological elements are better understood.

Occurrence. Werfen Formation, Muć, Dalmatia.

Repository. Natural History Museum, Vienna.

Genus *Arctomeekoceras* Popov, 1961
Type species, *Meekoceras rotundatum* Mojsisovics, 1886

Compressed, involute conchs, with narrowly rounded venters on earlier volutions tending to become more broadly rounded with age. Suture ceratitic with two lateral lobes and auxiliary series. The type and only species of the genus is known from the *Olenekites* fauna of Siberia. Indeterminate species have also been recorded from the upper part of the Lower Triassic succession in the Salt Range of West Pakistan (Kummel, 1966).

Arctomeekoceras rotundatum (Mojsisovics) Text-figure 36

Meekoceras rotundatum Mojsisovics, 1886: 83, pl. 10, fig. 16; Diener, 1915: 194.
Boreomeekoceras rotundatum,—Popov, 1961: 42.
Arctomeekoceras rotundatum,—Popov, 1962a: 187, pl. 1, figs. 1, 5, pl. 3, fig. 4

This is as yet an incompletely known species; Mojsisovics apparently had only one specimen and Popov four specimens but the illustrations and descriptions are incomplete. The key feature of the genus and species is the broadening of the venter on the adoral whorls. The suture (Fig. 36A) has two serrated lateral lobes and a small auxiliary on the umbilical wall.

Occurrence. Olenekites Zone, Lena River delta and Olenek River, Siberia.

Arctomeekoceras sp. indet. (West Pakistan) Text-figure 36

Arctomeekoceras sp. indet. Kummel, 1966: 398, pl. 2, figs. 1–5.

Generally incomplete and poorly preserved specimens that appear to be much like the type species of this genus, but more material is needed from both faunas before a significant comparison can be made. The suture is shown on Figure 36B.

Occurrence. Narmia Member of Mianwali Formation in Salt Range and Surghar Range of West Pakistan.

Repository. MCZ 9584–9586, 9589, 9590–9592.

Genus *Boreomeekoceras* Popov, 1961
Type species, *Meekoceras keyserlingi* Mojsisovics, 1886

Involute, compressed conch, venter nar-

rowly rounded, flanks convergent. Suture ceratitic with two lateral lobes and extended auxiliary series. The type and only species of this genus is from the *Olenekites* fauna of the Olenek region, northern Siberia.

Boreomeekoceras keyserlingi (Mojsisovics) Text-figure 36

Meekoceras keyserlingi Mojsisovics, 1886: 81, pl. 10, figs. 13–15; Diener, 1915: 192; Spath, 1934: 158, 254.
Boreomeekoceras keyserlingi,—Popov, 1961: 42, pl. 10, fig. 4.

This is a unique species in the known late Scythian faunas because of its tightly involute lenticular conch; the illustrations by Mojsisovics (1886: pl. 10, figs. 13–15) and Popov (1961: pl. 10, fig. 4) are quite satisfactory. The suture, however, in neither of these publications is well represented. A topotype specimen is available and two sutures from this specimen are shown on Figures 36 C, D.

Occurrence. *Olenekites* Zone near mouth of Olenek River, northern Siberia.

Repository. The MCZ has one topotype specimen, 8684.

Genus *Arctotirolites* Popov, 1963
Type species, *Pseudotirolites menensis* Popov, 1962

Arctotirolites menensis (Popov)

Pseudotirolites menensis Popov, 1962a: 178, pl. 2, fig. 4.
Arctotirolites menensis (Popov) 1963: 137.

This new genus and species was established on the basis of a single specimen. The illustration and description of the species leave much to be desired. The conch is moderately involute, compressed, and with an arched venter. The lateral areas bear sigmoidal folds which apparently end at the ventral shoulders in small nodes. The suture has two serrated lateral lobes and a serrated auxiliary lobe on the umbilical shoulder and wall.

On the basis of the nodes one is at first tempted to think of this form as a tirolitid of some sort. However, the greater involution of the conch and the suture does not support such a conclusion. On the basis of the very incomplete data, it seems more probable that this form is related to *Nordophiceras*. The suture of *menensis* is very much like that of a typical nordophicerid. In addition, some species of *Nordophiceras* are ornamented with ribs.

Occurrence. *Olenekites* Zone, Olenek River basin, Mene River, northern Siberia.

Family NORITIDAE Karpinsky, 1889

Genus *Albanites* Arthaber, 1909
Type species, *Pronorites triadicus* Arthaber, 1908

Albanites triadicus (Arthaber) Plate 16, figures 3–6; Plate 17, figures 1–10; Plate 18, figures 7, 8; Plate 20, figures 7–9; Text-figure 37

Pronorites triadicus Arthaber, 1908: 264, pl. 11, figs. 4a-c; Arthaber, 1911: 204, pl. 17(1), figs. 8, 9; Diener, 1915: 231; C. Renz, 1928: 155; Kutassy, 1933: 624; Renz and Renz, 1947: 61; Renz and Renz, 1948: 84, pl. 14, figs. 14–14b.
Albanites triadicus,—Spath, 1934: 275, fig. 95; Kummel, 1968b: 498, pl. 2, figs. 1–9.
Pronorites osmanicus Arthaber, 1911: 205, pl. 17 (1), fig. 10; Diener, 1915: 231; C. Renz, 1928: 155.
Albanites osmanicus,—Spath, 1934: 276.
Pronorites cf. *osmanicus*,—Renz and Renz, 1947: 62; Renz and Renz, 1948: 86, pl. 15, figs. 6-6c.
Pronorites arbanus Arthaber, 1911: 205, pl. 17(1), figs. 11, 12; Diener, 1915: 230; Welter, 1922: 94, pl. 155, figs. 10–14; C. Renz, 1928: 155; Kutassy, 1933: 624; C. Renz 1945: 301; Renz and Renz, 1947: 61; Renz and Renz, 1948: 85, pl. 14, figs. 13–13b, 15–15b, pl. 15, figs. 5–5c.
Albanites arbanus,—Spath, 1934: 277.
Pronorites arbanus var. *mediterranea* Renz and Renz, 1947: 62; Renz and Renz, 1948: 85, pl. 14, figs. 12–12b.
Pronorites spec. ind. ex aff. *arbani*,—Welter, 1922: 95, pl. 155(1), fig. 9.
Anasibirites gracilis Kiparisova, 1947: 164, pl. 39, figs. 3, 4, text-figs. 60, 61.
Pronorites arbanus var. *sundaica* Renz and Renz, 1948: 85.
Albanites welteri Spath, 1934: 278.
Pronorites orientalis Renz and Renz, 1947: 62; Renz and Renz, 1948: 86, pl. 15, figs. 2–2b.

Pronorites schaubi Renz and Renz, 1947: 62, 78; Renz and Renz, 1948: 87, pl. 15, figs. 4–4a.
Pronorites schaubi var. *timorensis* Renz and Renz, 1948: 87.
Pronorites schaubi var. *kephalovunensis* Renz and Renz, 1947: 62, 78; Renz and Renz, 1948: 87, pl. 15, figs. 3–3a.
Pronorites reicheli Renz and Renz, 1947: 62, 79; Renz and Renz, 1948: 88, pl. 15, figs. 1–1c.
Albanites danispanensis (Astakhova) 1960a: 143, pl. 34, figs. 4, 5; Astakhova, 1960b: 150.
Aspidites hasserti Arthaber, 1911: 249, pl. 21(5), fig. 16; Spath, 1934: 275.
Meekoceras (Koninckites) hasserti,—Diener, 1915: 198.
Dagnoceras komanum Arthaber, 1911: 242, pl. 21(5), fig. 11; Diener, 1915: 115; Smith, 1932: 65; Spath, 1934: 269, 275.
Pseudosibirites cfr. *dichotomus* Waagen,—Arthaber, 1911: 254, pl. 22(6), fig. 8.
Anasibirites cfr. *dichotomus*,—Arthaber, 1911: 273.
Sibirites cf. *dichotomus*,—Diener, 1915: 255.

The genus *Albanites* is a conspicuous member of the *Subcolumbites* fauna from Albania and Chios, from the Mangyshlak Peninsula, and from the *Prohungarites* fauna of Timor, but in none of these localities is the form particularly abundant. The genus is much better represented in Chios than in Albania, but the preservation of most of the specimens in these faunas often leaves much to be desired. It is factors of preservation and preparation of the Albanian specimens that have led to some of the misunderstanding about the genus. Examination of all the specimens in the Albania, Chios, and Timor collections leads me to conclude that they all represent a single species; there have been seven species and four variety names introduced for this group.

The holotype is a small specimen of only fair preservation; the lateral area and venter of the adoral quarter volution has been ground and polished to expose the suture. The smoothness of the venter commented on by Arthaber (1911: 205) and Spath (1934: 277) is the result of this grinding and polishing. The dimensions of the holotype are given on Table 43, and the suture is shown on Figure 37. At the time he introduced the species *triadicus* in 1908, Arthaber had only one specimen. In 1911

Table 43. Measurements of *Albanites triadicus* from the *Subcolumbites* faunas of Albania and Timor, and from Block "E," Nifoekoko, Timor.

	D	W	H	U	W/D	H/D	U/D
1.	55.8	26.1	22.4	15.8	46.8	40.1	28.3
2.	53.3	18.7	23.4	12.8	35.1	43.9	24.0
3.	49.2	14.2	22.3	10.1	28.9	45.3	20.5
4.	49.0	15.5	22.7	11.8	31.6	46.3	24.1
5.	40.0?	16.5	16.2?	10.1	41.3?	40.5?	25.3?
6.	38.4	13.5	16.1	11.7	35.2	41.9	30.5
7.	34.8	14.1	16.4	7.2	40.5	47.1	20.7
8.	34.7	12.8	14.4	11.4	37.1	41.5	32.9
9.	31.0	10.1	11.7	10.7	32.6	37.7	34.5
10.	28.7	8.7	11.8	9.1	30.3	41.1	31.7
11.	28.4	10.8	12.4	7.3	38.0	43.7	25.7
12.	28.2	8.4	14.4	4.4	29.8	51.1	15.6
13.	27.7	8.7	11.2	8.4	31.4	40.4	30.3
14.	25.8	9.0	12.0	6.1	34.9	46.5	23.6
15.	25.7	10.8	12.4	6.4	42.0	48.2	24.9
16.	25.0	10.5	11.1	6.4	42.0	44.4	25.6
17.	24.6	7.7	12.4	4.0	31.3	50.4	16.3
18.	?	?	?	12.8	?	?	?

1. Holotype, *Pronorites reicheli* Renz and Renz (1948: pl. 15, fig. 1), NHMB J13809.
2. Plesiotype, *Pronorites* sp. ind. ex aff. *arbani*,—Welter (1922: pl. 155(1), fig. 9), GPIBo W206.
3. Holotype, *Pronorites schaubi* Renz and Renz (1948: pl. 15, fig. 4), NHMB J13805.
4. Type specimen, *Pronorites schaubi* var. *kephalovunensis* Renz and Renz (1948: pl. 15, fig. 3), NHMB J13808.
5. Type specimen, *Pronorites osmanicus* Arthaber (1911: pl. 17(1), fig. 10), PIUV.
6. Plesiotype, *Pronorites arbanus*,—Renz and Renz (1948: pl. 14, fig. 15), NHMB J13795.
7. Syntype, *Albanites welteri* Spath (= *Pronorites arbanus*,—Welter, 1922: pl. 155, figs. 10–12), GPIBo W205b.
8. Type specimen, *Pronorites arbanus* var. *mediterranea* Renz and Renz (1948: pl. 14, fig. 12), NHMB J13800.
9. Plesiotype, *Pronorites arbanus*,—Renz and Renz (1948: pl. 14, fig. 13), NHMB J13796.
10. Holotype, *Pronorites orientalis* Renz and Renz (1948: pl. 15, fig. 2), NHMB J13801.
11. Plesiotype, *Pronorites triadicus*,—Renz and Renz (1948: pl. 14, fig. 14), NHMB J13793.
12. Syntype, *Albanites welteri* Spath (= *Pronorites arbanus*,—Welter, 1922: pl. 155, figs. 13, 14), GPIBo W205a.
13. Plesiotype, *Pronorites arbanus*,—Renz and Renz (1948: pl. 15, fig. 5), NHMB J13797.
14. Holotype, *Pronorites triadicus* Arthaber (1908: pl. 11, fig. 4), PIUV.
15. Plesiotype, *Pronorites* cf. *osmanicus*, Renz and Renz (1948: pl. 15, fig. 6c), NHMB J13804.
16. Plesiotype, *Pronorites* cf. *osmanicus*, Renz and Renz (1948: pl. 15, figs. 6–6b), NHMB J13803.
17. Lectotype, *Pronorites arbanus* Arthaber (1911: pl. 17 (1), figs. 11 a–d), PIUV.
18. Paralectotype, *Pronorites arbanus* Arthaber (1911: pl. 17(1), figs. 12 a, b), PIUV.

Specimens of numbers 5, 14, 17, 18 are from the *Subcolumbites* fauna of Albania; those of 2, 7, 12 are from the *Albanites* fauna of Timor; and the remaining specimens are from the *Subcolumbites* fauna of Chios.

he had one additional specimen to which, however, no specific reference was made. This specimen is illustrated here on Plate 17, figures 3, 4, and the dimensions are given on Table 43. As can be seen, it is a small juvenile form with a fairly inflated whorl section. The venter is broadly arched with rounded ventral shoulders; there are numerous weak ridges across the venter which disappear just above the ventral shoulders. This specimen differs from the holotype mainly in its slightly more inflated conch.

In 1911, Arthaber introduced two additional species for this group from the Albanian *Subcolumbites* fauna. For *Pronorites osmanicus* Arthaber (1911: 205, pl. 17(1), fig. 10; Pl. 17, figs. 5, 6 of this report) the author states he had six specimens. The illustrated specimen is the only one preserved in the collections of the Paleontological Institute, University of Vienna. There are two topotypes in the British Museum (Natural History). Arthaber's illustrated specimen is selected as the lectotype; this illustration is one of the least successful in Arthaber's monograph as it is highly modified. The specimen is all phragmocone, distorted, and generally of poor preservation. Much of the lateral area of the conch has been ground and polished to expose the suture. The adoral quarter volution bears prominent cross ridges, but the remainder of the venter is too poorly preserved to show this feature. The radial ribs on the flanks of the penultimate volution are not present on the specimen. The dimensions of the specimen are given on Table 43. This species was said to differ from *A. triadicus* in the presence of cross ridges on the venter and in slight differences in the suture (Fig. 37c). The smooth venter of the holotype of *A. triadicus* is due to grinding and polishing. The ridges are clearly present on the small second specimen assigned by Arthaber to *A. triadicus* (Pl. 17, figs. 3, 4).

Pronorites arbanus (Arthaber, 1911: 205, pl. 17(1), figs. 11, 12) was based on three specimens of which two were illustrated and are still preserved. This species was said to differ from *A. osmanicus* in its more compressed conch, greater involution, and slightly different proportions of the suture. The measurements of these two specimens are given on Table 43; the smaller of the two specimens (Pl. 17, figs. 9, 10) was selected by Spath (1934: 278) as lectotype. The paralectotype (Pl. 17, figs. 1, 2) has weak falcoid folds on the adoral half volution. This species is clearly only a compressed variant and is conspecific with the remaining forms of *Albanites* from Albania.

The collections from the *Subcolumbites* fauna of Chios studied by Renz and Renz (1948) contain approximately 50 specimens of *Albanites* which they placed in six species and two varieties. One species *(arbanus)* is represented by perhaps 20 specimens, two species *(triadicus* and *schaubi)* were recognized on eight specimens each, one species *(orientalis)* on four specimens, one species (cf. *osmanicus*) on two specimens, and one species and two varieties on the basis of a single specimen each. The measurements of the prepared and more complete specimens of *Albanites* in the Renz and Renz collections from Chios are given on Table 43. The basic difference between all these species lies in the degree of compression of the conch, in degree of ornamentation, and in degree of involution of the conch. Examination of the Chios collection indicates to me that these characters are highly gradational and the numerous species names are merely labels applied to possessors of a particular morphological character within a completely gradational complex. Much of the discussion of these species by Renz and Renz (1948) is confusing and out of date due to their oversight of some of the earlier literature.

There has been some question and doubt as to whether the two specimens from Timor, described by Welter (1922) as *Pronorites arbanus*, are the inner whorls of the same species that Welter described as *Pronorites* spec. ind. ex aff. *arbani*. Exami-

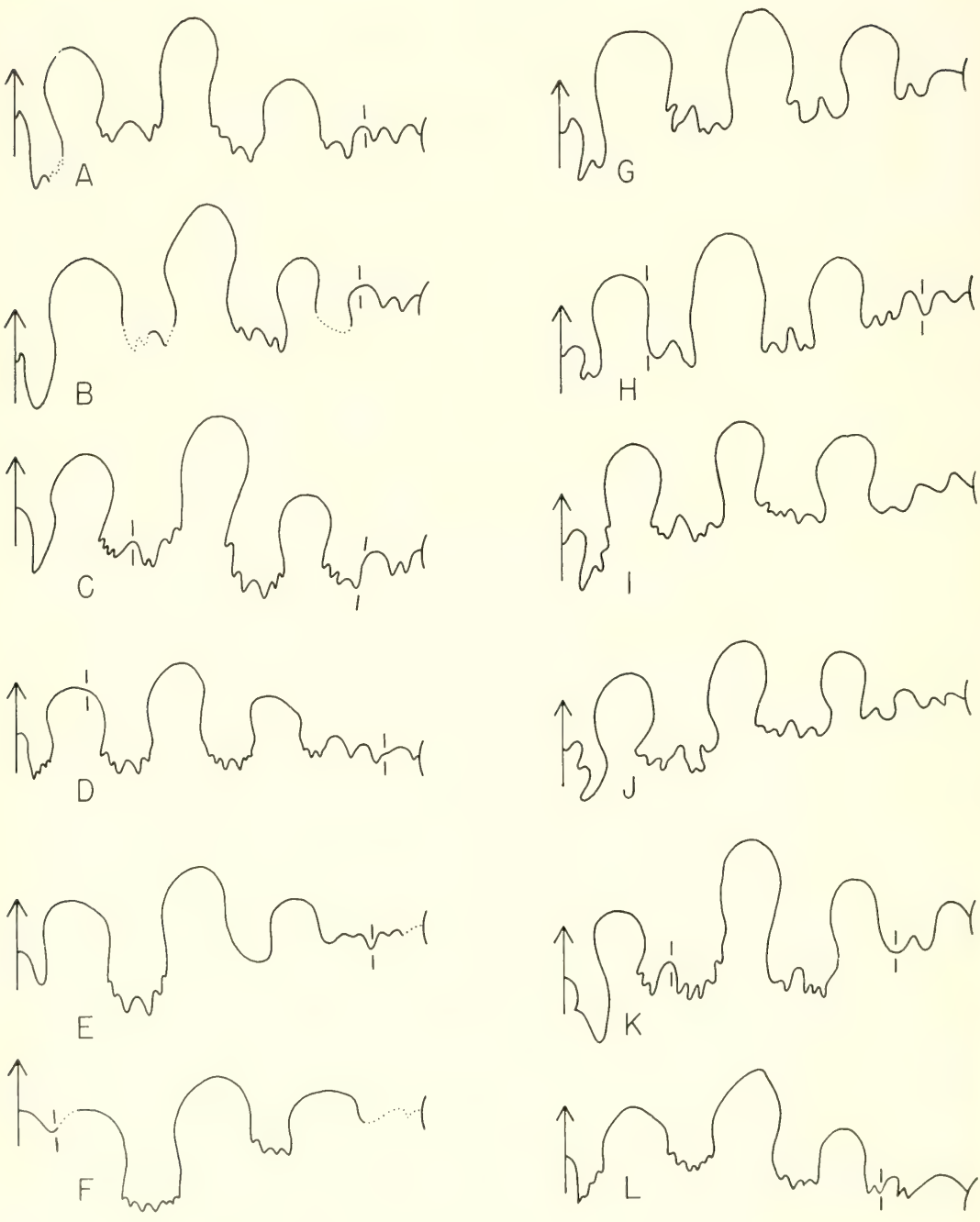

Figure 37. Diagrammatic representation of the sutures of *Albanites triadicus* (Arthaber). A, holotype (Arthaber, 1911: pl. 17(1), fig. 8), redrawn suture at diameter of 30 mm; B, paratype (Arthaber's second and smaller specimen of *triadicus*), at a diameter of 18 mm; C, figured type of *A. osmanicus* (Arthaber, 1911: pl. 17(1), fig. 10), redrawn suture at a diameter of 38 mm; D, lectotype of *A. arbanus* (Arthaber, 1911: pl. 17(1), fig. 11), redrawn suture at a diameter of 23 mm; E, holotype of *Dagnoceras komanum* Arthaber (1911: pl. 21(5), fig. 11), redrawn suture at a diameter of 18 mm; this specimen has been ground and polished so that the fine details of the sutural elements have been destroyed; F, type

nation of Welter's original specimens leaves no doubt on this question. Spath (1934: 278) came to the same conclusion on examination of a fine series of specimens in the British Museum (Natural History). Spath (1934) recognized the "external resemblance" to the Albanian *A. arbanus*, but felt because there were differences in the suture that a new name was needed, and he introduced the name *A. welteri*. The differences in the suture, however, are no more than what one can observe within the Albanian and Chios faunas.

Albanites danispanensis (Astakhova, 1960a) was stated to resemble *A. osmanicus* Arthaber and *A. arbanus* Arthaber, differing, however, in size of the umbilicus, ornamentation, and details of the suture. On the basis of the illustrations and descriptions of this species, none of these differences appear to be significant against the range of variation known to exist in the Albanian and Chios forms. This species from the Mangyshlak Peninsula can be considered as a representative of *A. triadicus*.

Finally, there is a group of species from the *Subcolumbites* fauna, based on very poorly preserved specimens; an inspection of the types suggests inclusion in this species. First, there is the specimen for which Arthaber (1911: 242, pl. 21(5), fig. 11; Pl. 18, figs. 7, 8 of this report) proposed the name *Dagnoceras komanum*. This specimen measures 27 mm in diameter, 7.2 mm for the width of the adoral whorl, 12.7 mm for the height, and 6.3 mm for the diameter of the umbilicus. The whorls are compressed, converging slightly toward a flattened venter. Both the ventral and umbilical shoulders are sharply rounded. On the adoral one-third volution the ventral shoulders bear diagonal ribs; the venter is not well enough preserved to tell just how these ribs cross the venter. In the better preserved specimen of *A. triadicus*, cross ridges on the venter are connected with weak radial ribs on the flanks. I am inclined to believe that the diagonal, projecting ribs on the ventral shoulder of the holotype of *Dagnoceras komanum* are at least partially due to the poor state of preservation of the specimen and possibly to slight crushing. Thus the difference in the rib pattern from that of the type specimen of *A. triadicus* is more apparent than real.

The specimen Arthaber (1911: pl. 22(4), figs. 8a-c; Pl. 20, figs. 7–9 of this report) assigned to *Pseudosibirites* cfr. *dichotomus* Waagen I believe to be essentially identical to the specimen he assigned to *Dagnoceras komanum*. This conclusion is made taking into account the poor and slightly different preservations of these two specimens. The lateral ribs are more conspicuous, as is the chevron aspect of the ribs across the venter. The specimen is, however, slightly crushed laterally.

The sutures of these species are shown on Figure 37E, F. First of all, it can be seen that they are essentially identical; any differences can readily be explained by excessive grinding of the specimen. Secondly, it can be seen that these two sutures are essentially identical to the sutures of the specimens of *Albanites* so far known from the Albanian *Subcolumbites* fauna.

←

specimen of *Pseudosibirites* cfr. *dichotomus*,—Arthaber (1911: pl. 22(6), fig. 8), redrawn suture at a diameter of 18 mm; G, plesiotype of *A. arbanus*,—Renz and Renz (1948: pl. 14, fig. 13b), at a diameter of 20 mm (NHMB J13796); H, plesiotype of *A. arbanus*,—Renz and Renz (1948: pl. 14, fig. 15b), at a diameter of 25 mm (NHMB J13795); I, plesiotype of *A. arbanus* var. *mediterranea* (Renz and Renz, 1948: pl. 14, fig. 12b), at a diameter of 24 mm (NHMB J13800); J, plesiotype (Renz and Renz, 1948: pl. 14, fig. 14b), at a diameter of 17 mm (NHMB J13793); K, holotype of *Pronorites reicheli* Renz and Renz (1948: pl. 15, fig. 1c), at a diameter of approximately 40 mm (NHMB J13809); L, paratype of *Albanites danispanensis* (Astakhova, 1960a: fig. 10), at a diameter of 30 mm.

Specimens of figures A–F from *Subcolumbites* fauna of Albania, those of G–K from *Subcolumbites* fauna of Chios; specimen of figure L from the Mangyshlak Peninsula.

Considering all the factors available for these two "species," I believe it best to consider them as conspecific with *Albanites triadicus* of the same fauna. The differences in the rib pattern on the venter are difficult to evaluate on the basis of the sample available. No purpose is served in assigning these two forms to different genera.

Further, I suggest that the two specimens Arthaber (1911: 249, pl. 21(5), fig. 16) assigned to *Aspidites hasserti* Arthaber are poorly-preserved representations of *A. triadicus*. Arthaber's figured type (Pl. 16, figs. 3, 4) measures 44.6 mm in diameter, 14.3 mm for the width of the adoral whorl, 20.8 mm for the height, and 10.5 mm for the diameter of the umbilicus. In addition to being poorly preserved, the specimen has been ground and polished in places. The basic plan of the suture is that of *A. triadicus*. The smaller unfigured specimen referred to by Arthaber (1911: 249) is illustrated here on Plate 16, figures 5, 6. This specimen measures 22.4 mm in diameter, 6.6 mm for the width of the adoral whorl, 11.7 mm for the height and 2.5 mm for the diameter of the umbilicus. In both these specimens the basic conch form and suture show them to be close to *A. triadicus*; what differences are apparent can be readily explained as due to the state of preservation or due to grinding and polishing.

Occurrence. The species is known from the *Subcolumbites* fauna of Albania, Chios, and Afghanistan, from the *Prohungarites* fauna of Timor, and from the *Columbites* Zone of Astakhova (1960a, b) on the Mangyshlak Peninsula.

Repository. The Paleontological Institute, University of Vienna contains the holotype, and the second specimen referred to as *Pronorites triadicus* by Arthaber (1911: 204; figured here Pl. 17, figs. 3, 4), the lectotype of *Pronorites osmanicus* Arthaber, the lectotype and paralectotype of *Pronorites arbanus* Arthaber. This institution also contains the holotype of *Dagnoceras komanum* Arthaber, the figured specimen of *Pseudosibirites* cfr. *dichotomus* Waagen, and the lectotype and paralectotype of *Aspidites hasserti* Arthaber. The Natural History Museum, Basel, contains the following specimens: plesiotype *Pronorites triadicus*,—Renz and Renz (1948: pl. 14, fig. 14) NHMB J13793; unfigured specimens NHMB J13794; plesiotypes *Pronorites arbanus*,—Renz and Renz (1948: pl. 14, fig. 15) NHMB J13795, (pl. 14, fig. 13) NHMB J13796, (pl. 15, fig. 5) NHMB J13797; unfigured specimens from Maradovuno NHMB J13798, from Kephalovuno NHMB J13799; figured specimens *Pronorites arbanus* var. *mediterranea* Renz and Renz (1948: pl. 14, fig. 12) NHMB J13800; holotype *Pronorites orientalis* Renz and Renz (1948: pl. 15, fig. 2) NHMB J13801; unfigured paratypes NHMB J13802; figured specimens of *Pronorites* cf. *osmanicus* Renz and Renz (1948: pl. 15, fig. 6–6b) NHMB J13803, (pl. 15, fig. 6c) NHMB J13804; holotype *Pronorites schaubi* Renz and Renz (1948: pl. 15, fig. 4–4a) NHMB J13805; unfigured paratypes from Maradovuno NHMB J13806, from Kephalovuno NHMB J13807; figured specimen of *Pronorites schaubi* var. *kephalovunensis* Renz and Renz (1948: pl. 15, fig. 3–3a) NHMB J13808; holotype *Pronorites reicheli* Renz and Renz (1948: pl. 15, fig. 1–1c) NHMB J13809. The three specimens studied by Welter (1922) are in the Paleontological Institute, Bonn University; additional topotype specimens are in the British Museum (Natural History); specimens from Afghanistan MCZ 10136, 10145, 10152, 10153, 10156, 10168.

Family PRIONITIDAE Hyatt, 1900

Genus *Hemiprionites* Spath, 1929

Type species, *Goniodiscus typus* Waagen, 1895

Hemiprionites costatus Popov

This species is based on a single specimen which unfortunately is incompletely described and illustrated. On the basis of the data available, I can only concur in

Popov's generic assignment of this species. The genus *Hemiprionites* had previously been known only from the *Anasibirites* Subzone of the *Owenites* Zone. In this mid-Scythian horizon it is a very common and quite distinctive form. Popov (1961) states this species is associated with *Inyoites eiekitensis* Popov (here assigned to *Subvishnuites*) and *Dieneroceras nikabitensis* Popov (here considered to be a synonym of *D. demokidovi* Popov). Both these associated species are generalized forms, and it is possible all of these species belong to the *Owenites* Zone and are not equivalent to the *Columbites* Zone as are most of the faunas assigned by Popov (1961) to his *Dieneroceras* Zone.

Occurrence. Olenek River basin, northern Siberia.

Family SIBIRITIDAE Mojsisovics, 1896

Genus *Sibirites* Mojsisovics, 1886

Type species, *Ceratites eichwaldi* Keyserling, 1845

Sibirites eichwaldi (Keyserling)

Ceratites eichwaldi Keyserling, 1845: pl. 3, fig. 14; Eichwald, 1868: 1040; Mojsisovics, 1882: 41.

Sibirites eichwaldi,—Mojsisovics, 1886: 59, pl. 10, figs. 1–9; Frech, 1905: pl. 28, fig. 10; Diener, 1915: 255; Spath, 1934: 342, 344, figs. 116d, e; Kiparisova, 1947: 164; Popov, 1961: 31, pl. 14, fig. 2; Vozin and Tikhomirova, 1964: 63, pl. 38, figs. 1, 2.

Sibirites cf. *eichwaldi*,—Popov, 1961: 31, pl. 14, fig. 6.

Sibirites pretiosus Mojsisovics, 1886: 61, pl. 10, fig. 10; Diener, 1915: 256; Spath, 1934: 343, figs. 116a–c; Popov, 1961: 32, pl. 13, fig. 1a; Vozin and Tikhomirova, 1964: 64, pl. 38, fig. 3.

Sibirites ind. aff. *pretioso* Mojsisovics, 1886: 61, pl. 10, figs. 11, 12; Diener, 1915: 256.

Sibirites grambergi Popov, 1961: 31, pl. 14, fig. 1.

Parasibirites grambergi (Popov), 1962a: 181, pl. 1, fig. 3.

Sibirites grambergi var. *rariaculeatus* Popov, 1961: 31, pl. 14, fig. 5.

Parasibirites rariaculeatus Popov, 1962a: 182, pl. 1, fig. 2.

Sibirites grambergi var. *mixta* Popov, 1961: 31, pl. 14, fig. 7.

Parasibirites mixtus Popov, 1962a: 183, pl. 1, fig. 4.

Sibirites subpretiosus Popov, 1961: 33, pl. 14, fig. 8.

Parasibirites subpretiosus (Popov), 1962a: 181.

The large number of species brought together here reflect the usual typological treatment of trachyostracan ammonites. The "species" differ in degree of ornamentation, that is, in the relative prominence of ribs, nodes, etc. These species have now been recorded from a number of localities in northern Siberia, especially at and around the Olenek region. Neither Mojsisovics (1886) nor Popov (1961, 1962a) had particularly large collections to study nor did they present much data on the variability within their samples. I shall make the prediction that when large collections of *Sibirites* from the Olenek region become available they will show a complete gradational series from lesser to stronger ornamented forms, and that the ontogenetic development will be found to be also highly variable. I look upon *Sibirites* as having the same range of genetic variability as is seen, for instance, in *Anasibirites kingianus* or *Columbites parisianus*, both species known by large samples.

Occurrence. Olenekites Zone, northern Siberia, Olenek River, Verkhoyan region, Kolyma River basin, and eastern Taymyr.

Sibirites renzi n. sp.
Plate 24, figures 6–9

Anasibirites aff. *anguloso* (Waagen),—Renz and Renz, 1947: 60; Renz and Renz, 1948: 35, pl. 11, figs. 10, 11.

The Renzes (1948) listed only two specimens of this species, but there are in the collections four additional paratypes. The preservation of all the specimens leaves much to be desired. The shape of the conch, degree of involution, and pattern of ornamentation place this species in *Sibirites*. The ribs are slightly interrupted in their passage over the venter; in *Anasibirites* the ribs are continuous over the venter.

Occurrence. Subcolumbites fauna, Chios.

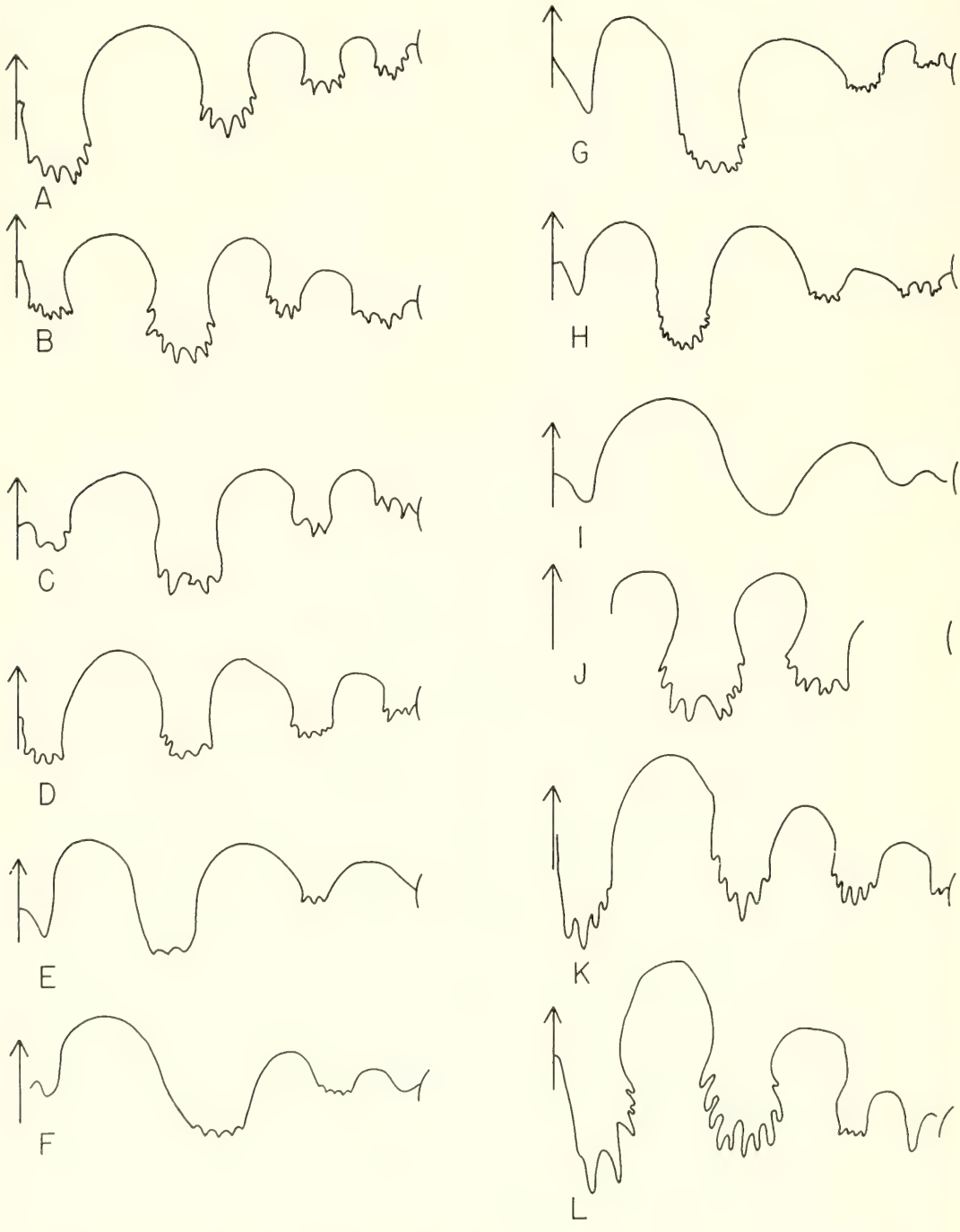

Figure 38. Diagrammatic representation of the suture of: A, *Keyserlingites subrobustus* (Mojsisovics, 1886: pl. 4, fig. 2c), at a diameter of approximately 85 mm; B, *Keyserlingites middendorffi* (Keyserling)—Mojsisovics (1886: pl. 3, fig. 1c), at a diameter of approximately 100 mm; C, *Ceratites nikitini* Mojsisovics (1888: pl. 1, fig. 13c), at a diameter of approximately 25 mm; D, *Ceratites bungei* Mojsisovics (1888: pl. 1, fig. 14c), at a diameter of approximately 50 mm; E, holotype Key-

Repository. Holotype, Renz and Renz (1948: pl. 11, fig. 10) NHMB J13623; paratype, Renz and Renz (1948: pl. 11, fig. 11) NHMB J13624; Pl. 24, figs. 6, 7 of this report, NHMB J19551; Pl. 24, figs. 8, 9 of this report, NHMB J19552; unfigured paratypes NHMB J13625.

Genus *Keyserlingites* Hyatt, 1900

Type species, *Ceratites subrobustus* Mojsisovics, 1885

There are now five late Scythian species of this genus confined to the circum-Arctic region and in western North America. Four of these species (*subrobustus, middendorffi, bearlakensis,* and *bearriverensis*) are confined to the *Prohungarites* Zone, and one species (*stephensoni*) is from the *Columbites* Zone. On the basis of studies on several well preserved specimens of *Keyserlingites subrobustus* from British Columbia and Ellesmere Island, Tozer (1965a) has been able to clarify the relations between *Keyserlingites* and *Durgaites.* Tozer's suggestion, however, that the Himalayan "*Durgaites*" *dieneri* and the Timor "*D.*" *angustecostatus* may be upper Scythian in age rather than Anisian, as concluded by Diener (1907, 1912), Spath (1934) and Welter (1915), is here rejected. This question has been fully discussed in the introductory chapter (p. 348).

Keyserlingites subrobustus (Mojsisovics) Plate 26, figures 6, 7; Text-figure 38

Ceratites middendorffi Keyserling, 1845: pl. 2, fig. 4.

Ceratites subrobustus Mojsisovics, 1885: 155, pl. 6, fig. 3; Mojsisovics, 1886: 44, pl. 4, fig. 2, pl. 5, figs. 1a, b, pl. 6, fig. 1; Noetling, *in* Frech, 1905: 194, 200, pl. 28, fig. 5a, b.

Keyserlingites subrobustus,—Hyatt, 1900: 559; Diener, 1915: 172; Spath, 1934: 355, fig. 119a–c; Kummel, 1961: 521; Popov, 1961: 55, pl. 15, fig. 1; Tozer, 1965a: 31, pl. 5, fig. 1, pl. 6, figs. 1, 2, pl. 7, figs. 1–3, pl. 8, figs. 1, 2; Tozer, 1965b: 5.

Robustites subrobustus,—Philippi, 1901: 556.

Keyserlingites cf. *subrobustus,*—Frebold, 1929a: 12, pl. 2, figs. 8, 9; Tozer, 1962, pl. 4, figs. 6a–c.

Ceratites bungei Mojsisovics, 1888: 8, pl. 1, fig. 14; Spath, 1934: 356.

Keyserlingites bungei,—Diener, 1915: 178; Popov, 1961: 54.

This species has recently been extensively described and illustrated by Tozer (1965a) on the basis of specimens from Ellesmere Island and British Columbia which have contributed much to our knowledge of this most interesting form. *Ceratites bungei* (Fig. 38D) is believed to be based upon a juvenile specimen of *K. subrobustus.* The differences in the two Arctic species of *Keyserlingites* are largely in the nature of the whorl section. This species has a subquadrate whorl section, whereas *middendorffi* is a much more compressed form. *Keyserlingites bearlakensis* n. sp. has a suture quite similar to *subrobustus* (Fig. 38A) but a simpler pattern of ornamentation with only a single set of lateral bullae. The other species of *Keyserlingites* in the *Prohungarites* Zone of southeast Idaho, *bearriverensis,* is a compressed form like the Siberian *middendorffi.*

Occurrence. The type specimens came from the *Olenekites* Zone at the mouth of the Olenek River, Siberia. The species is also known from Spitsbergen at Cape

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serlingites bearriverensis n. sp., at a diameter of 50 mm; F, paratype *Keyserlingites bearriverensis* n. sp., at a diameter of 9.5 mm (MCZ 9521); G, holotype *Keyserlingites bearlakensis* n. sp., at a whorl height of 24 mm (MCZ 9516); H, paratype *Keyserlingites bearlakensis* n. sp., at a whorl height of 25 mm (MCZ 9523); I, paratype *Keyserlingites bearlakensis* n. sp., at a diameter of 7.3 mm (MCZ 9518); J, holotype *Keyserlingites stephensoni* n. sp. at a diameter of 190 mm; K, holotype *Ceratites subrobustus* Diener (1897: pl. 19, fig. 2) (=*Keyserlingites dieneri*), at a diameter of approximately 110 mm; L, *Keyserlingites angustecostatus* Welter (1915: 108, fig. 12).

Specimens of figures A–D from *Olenekites* Zone, Olenek River region, Siberia; of E–I from Upper Thaynes Formation, Hammond Creek, southeast Idaho; J, from Thaynes Formation, Fort Hall Indian Reservation presumably from *Columbites* Zone; K, lower Anisian, Himalayas and Tibet; L, lower Anisian, Nifoekoko, Timor.

Thordson (Frebold, 1929a), and from the *Grippia* beds, Botneheia, south of Sassanfiord (Tozer, 1962). On Ellesmere Island the species is present in the Blaa Mountain Formation and the Blind Fiord Formation, and in British Columbia in the Toad Formation in the Halfway River area (Tozer, 1965a).

Repository. The Siberian specimens are in the Central Geological Museum, Leningrad. The Spitsbergen specimen reported by Frebold (1929a) is in the Paleontological Museum, Oslo; another Spitsbergen specimen, collected by Frebold and illustrated by Tozer (1965a) is in the Geological Survey of Canada and a plastotype in the Museum of Comparative Zoology. The Ellesmere Island and British Columbia species are in the Geological Survey of Canada.

Keyserlingites middendorffi (Keyserling)

Ceratites middendorffi Keyserling, 1845: 170, pl. 1, fig. 1; pl. 2, figs. 1, 3 (non 2, 4); Mojsisovics, 1882: 11; Mojsisovics, 1885: 153, pl. 6, fig. 2; Mojsisovics, 1886: 38, pl. 2, figs. 12, 13, pl. 3, figs. 1a–c, pl. 20, fig. 10; Frech, 1905: 200; Spath, 1934: 359.

Ammonites middendorffi,—v. Buch, 1848: 15.

Ceratites (?*Stephanites*) *middendorffi*,—Frech, 1905: pl. 28, fig. 7.

Keyserlingites middendorffi,—Diener, 1907: 44; Diener, 1915: 178; Spath, 1934: 33, 353, 355, 356, 363, 432, fig. 119d; Kummel, 1961: 521; Popov, 1961: 54, pl. 15, figs. 2, 3.

Ceratites nikitini Mojsisovics, 1888: 6, pl. 1, figs. 12, 13.

Keyserlingites nikitini,—Diener, 1915: 179; Popov, 1961: 56, pl. 15, fig. 4.

Ceratites schrenki Mojsisovics, 1886: 47, pl. 4, fig. 1.

Keyserlingites schrenki,—Diener, 1915: 179.

Of the two species of Siberian keyserlingitids this is the compressed form. It differs from *subrobustus* also in ornamentation, with its prominent nodes just below the umbilical shoulder and only weak ridges crossing the venter. *Keyserlingites nikitini* (Mojsisovics) is much like *middendorffi* except for being more evolute. That species is known from only three specimens and the difference in involution of the conch from *middendorffi* is a little less than 10 percent. As these two "species" are associated in the same beds, I feel it more likely that *nikitini* is nothing more than an evolute variant of *middendorffi*. In the same vein one can look upon *Keyserlingites schrenki* (Mojsisovics) as an involute variant of *middendorffi*. In its compressed whorls *K. middendorffi* is similar to *K. bearriverensis* n. sp. from southeast Idaho, but the two species differ significantly in their ornament pattern.

The sutures of these species are illustrated on Figure 38.

Occurrence. This species is only known from northern Siberia where it occurs in the *Olenekites* Zone at the mouths of the Lena and Olenek rivers, in the Kolyma River basin of the Verkhoyan region, and in eastern Taymyr.

Repository. The Siberian specimens are in the Central Geological Museum, Leningrad. The Museum of Comparative Zoology has a specimen from the delta region of the Lena River (MCZ 6108).

Keyserlingites bearlakensis n. sp.
Plate 37, figures 5, 6; Plate 38, figures 1–3; Text-figure 38

Keyserlingites n. sp. cf. *K. subrobustus* (Mojsisovics),—Kummel, 1954: 187.

The largest ammonoids in the upper member of the Thaynes Formation at Hammond Creek, Bear River Range, southeast Idaho, are species of *Keyserlingites*. This species is represented by ten, mainly fragmentary, specimens. The conch is evolute with an umbilicus measuring approximately 30 percent of the diameter. The whorls are depressed, being wider than high, with a broadly arched venter. The lateral areas are likewise convex and merge onto a broadly rounded umbilical slope. The conch is ornamented with large, prominent bullae on the lateral areas. On the holotype (Pl. 38, figs. 1, 2), there are nine bullae on the half volution. The bullae

occupy the entire lateral area. Between the bullae there may or may not be low, weak ribs extending across the venter from one ventral shoulder to the other. The suture is shown on Figures 38G–I.

The collections contain one small specimen of 7.8 mm in diameter, which is believed to be the juvenile whorls of this species (Pl. 37, figs. 5, 6). What is of special interest in this specimen is that at this diameter it already has all of the main morphological features of the large adult specimens. This includes the depressed whorl section, bullae, and suture (Fig. 38I).

The Tobin Formation of the Tobin Range, Nevada, has yielded a few poorly preserved, fragmentary specimens that are possibly conspecific with this species. In its depressed whorls this species is much like the Arctic *K. subrobustus* but differs in ornament pattern.

Occurrence. Upper member of Thaynes Formation, Hammond Creek, Bear River Range, southeast Idaho.

Repository. Holotype MCZ 9561 (Pl. 38, figs. 1, 2); figured paratypes MCZ 9517 (Pl. 38, fig. 3), MCZ 9518 (Pl. 37, figs. 5, 6); unfigured paratypes MCZ 9519.

Keyserlingites bearriverensis n. sp.
Plate 37, figures 1–4; Text-figure 38

It was pointed out above that of the two Siberian species of *Keyserlingites*, one was a form with a depressed whorl section (*K. subrobustus*) and the other was a form with a compressed whorl section (*K. middendorffi*). A similar relationship exists with two species of *Keyserlingites* that occur in the upper member of the Thaynes Formation at Hammond Creek, Bear River Range, southeast Idaho. Of the compressed species the collections contain eight poorly preserved specimens.

The venter is highly arched, grading onto convex lateral areas; the umbilical shoulder and wall are broadly convex. Prominent bullae on the lateral areas extend from the umbilical shoulder to the ventral shoulder; they are essentially radial on the phragmocone but on the living chamber become slightly prosiradiate. The suture is shown on Figure 38E, F.

The collection contains a small specimen of 9.8 mm in diameter which is believed to be a juvenile of this species. Like the juvenile specimen of *K. bearlakensis* described above, this specimen already has the essential features of the adult. That is, the compressed whorl section, high, arched venter, and bullae are clearly developed. The suture has the basic pattern of lobes and saddles, but the lobes are only slightly denticulated (Fig. 38F).

In the compressed nature of the conch this species is similar to *K. middendorffi*. It differs from that species in the nature of the bullae and of the venter.

The fact that each of the Siberian and Idaho late Scythian faunas have two species, one compressed in whorl section, the other depressed, tempts one to consider the possibility that these are dimorphs of one species in each case. However, the material available from each fauna is far too limited to explore this problem further.

Occurrence. Upper member of the Thaynes Formation, Hammond Creek, Bear River Range, southeast Idaho.

Repository. Holotype MCZ 9520 (Pl. 37, figs. 1, 2); figured paratype MCZ 9521 (Pl. 37, figs. 3, 4); unfigured paratypes MCZ 9522.

Keyserlingites stephensoni n. sp.
Plate 46, figure 1; Text-figure 38

This species is based on the largest specimen of an ammonite discovered in the Lower Triassic formations of western United States. It was discovered by Gordon R. Stephenson of the U.S. Agricultural Research Service of Boise, Idaho, in whose honor the species is named. The specimen measures 268.0 mm in diameter, 106 mm for the height of the last whorl, and 80 mm for the diameter of the umbilicus. The

specimen was broken out of a large black limestone concretion, and one side is embedded in matrix. Even though a width measurement is not possible, it is clear that the whorls are higher than wide. The lateral areas are broadly convex, and slightly convergent; the venter is broadly arched. Both the ventral and umbilical shoulders are rounded.

The most striking feature of the specimen is its ornamentation. On the umbilical shoulder are large nodes. On the last volution there are seven such nodes that adorally increase in size. On the ventral shoulder there are slightly elongated nodes (clavi) which also increase in size adorally. There are approximately twice as many nodes on the ventral shoulder as on the umbilical shoulder.

The shell is preserved over much of one side of the specimen. The shell in the region of the nodes measures as much as 5 mm in thickness. On the mid-part of the venter the shell is only 2 mm thick.

The suture is only partially known, that is, the first lateral lobe, second lateral saddle, and the second lateral lobe are visible (Fig. 38J). This species is remarkably similar in its gross feature to the specimen of *Keyserlingites middendorffi* figured by Mojsisovics (1886: pl. 3) from the Olenek fauna of northern Siberia. The Idaho specimen lacks the transverse ventral ribs, and has more prominent nodes on the ventral shoulder. It differs from *Keyserlingites subrobustus*, also from the Olenek fauna, and from *Keyserlingites bearlakensis* in its compressed rather than depressed whorl section.

Occurrence. From the lower black limestone member of the Thaynes Formation, Fort Hall Indian Reservation, southeast Idaho. The specimen is presumably from a horizon equivalent to the *Columbites* fauna of the Bear Lake region.

Repository. This specimen has been presented by Mr. G. R. Stephenson to the Department of Geology, Washington State University, Pullman, Washington.

Keyserlingites sp. indet. (Afghanistan)

Keyserlingites sp. indet. Kummel, 1968b: 500, pl. 1, figs. 5–7.

A small specimen, 22 mm in diameter, is the first record of the genus *Keyserlingites* in late Scythian strata of Tethys. The specimen appears to be all phragmocone and has a whorl height of 9 mm and an umbilical diameter of 7.5 mm. The whorl sides are slightly convex and converge toward a broadly rounded venter. The umbilical shoulder is abruptly rounded and the umbilical wall nearly vertical. There are large nodes, one approximately every quarter volution, that are anchored on the umbilical shoulder and extend upward on the flanks. The most adoral node, at a diameter of 21 mm, extends half way across the lateral areas. The suture consists of a simple pronged ventral lobe, a large first lateral saddle and first lateral lobe, and much smaller second lateral saddle and lobe; a low denticulated auxiliary lobe occupies the umbilical wall. The general shape of the conch, the nodes, and the suture identifies this specimen as *Keyserlingites*. The specimen is most probably a juvenile form.

Occurrence. Subcolumbites fauna, Kotal-e-Tera, Afghanistan.

Repository. MCZ 10139.

Genus *Olenekites* Hyatt, 1900

Type species, *Dinarites spiniplicatus* Mojsisovics, 1886

Olenekites spiniplicatus (Mojsisovics)

Dinarites spiniplicatus Mojsisovics, 1886: 10, pl. 1, figs. 1–5, 8–16, 18–26, pl. 2, figs. 1–5, 7; Mojsisovics, 1888: 2, pl. 1, figs. 1–3; Frech, 1905: pl. 28, fig. 9.

Olenekites spiniplicatus,—Hyatt, 1900: 559; Spath 1934: 361, pl. 7, fig. 3; Kiparisova, 1947: 166; Kummel, *in* Arkell et al., 1957: L146, figs. 178, 5; Popov, 1961: 34, pl. 14, figs. 3, 4; Vozin and Tikhomirova, 1964: 67, figs. 4–7.

Dinarites (*Olenekites*) *spiniplicatus*,—Diener, 1915: 123.

Dinarites volutus Mojsisovics, 1886: 14, pl. 1, fig. 6, pl. 2, fig. 6; Mojsisovics, 1888: 4, pl. 1, figs. 5, 6.

Dinarites (*Olenekites*) *volutus*,—Diener, 1915: 124.

Dinarites densiplicatus Mojsisovics, 1886: 15, pl. 1, fig. 7; Mojsisovics, 1888: 4, pl. 1, fig. 4.
Dinarites (Olenekites) densiplicatus,—Diener, 1915: 123.
Dinarites altus Mojsisovics, 1886: 16, pl. 2, fig. 8.
Dinarites (Olenekites) altus,—Diener, 1915: 123.
Olenekites altus,—Popov, 1961: 35, pl. 13, fig. 1b; Vozin and Tikhomirova, 1964: 68, pl. 33, fig. 3.
Dinarites intermedius Mojsisovics, 1886: 17, pl. 2, fig. 9.
Dinarites (Olenekites) intermedius,—Diener, 1915: 123.
Dinarites glacialis Mojsisovics, 1886: 18, pl. 2, fig. 11.
Dinarites (Olenekites) glacialis,—Diener, 1915: 123.
Olenekites glacialis,—Popov, 1961: 34, pl. 13, fig. 16.

Both Mojsisovics (1886) and Spath (1934) have made particular note of the large degree of variation in nearly all morphological features in this species. Mojsisovics had 64 specimens of *spiniplicatus*, but for the remaining five species he assigned to his *Dinarites* he had only one, two, or three specimens per species. Restudy of the type specimens, topotype material, and the literature of Mojsisovics (1886, 1888) and Popov (1961) demonstrate clearly that there is but one species of *Olenekites* in this north Siberian region.

Occurrence. Northern Siberia, mainly at and around mouth of Olenek River.

Repository. The Museum of Comparative Zoology contains a number of topotype specimens (MCZ 8682, 8683). The Central Geological Museum, Leningrad, contains the types of Mojsisovics and Popov.

Olenekites mangyshlakensis Astakhova

Olenekites mangyshlakensis Astakhova, 1960a: 148, pl. 34, figs. 6, 7, text-fig. 14.

This species is obviously quite close to *O. spiniplicatus* and could possibly be conspecific. However, since data available on this species are so incomplete, it seems best to accept it as a separate and distinct species.

Occurrence. Mangyshlak Peninsula, Karatauchik Range, from *Columbites* Zone of Astakhova, 600–650 m above base of Tyur-Upa suite.

Olenekites canadensis Tozer

Olenekites canadensis Tozer, 1961a: 73, pl. 18, figs. 1–3; Tozer, 1965a: 32, pl. 4, figs. 1–8, text-fig. 10.

This is likewise a highly variable species, differing from *O. spiniplicatus* mainly in its truncate venter.

Occurrence. Blaa Mountain Formation, upper Scythian, Ellesmere Island.

Olenekites cf. *spiniplicatus* (Mojsisovics)
Plate 36, figures 4–6

Previously, the two available specimens of this species were assigned to *Olenekites*, with question, as no suture is preserved (Kummel, 1954). In recent years, I have had the opportunity of examining numerous specimens of *Olenekites* from the type locality at the mouth of the Olenek River, northern USSR, and no longer have any doubt but that these specimens represent a species of *Olenekites*. Each specimen consists of only one-half volution. The whorls are approximately as high as wide; the venter is broadly rounded, as are the ventral shoulders. The umbilical shoulders are more abruptly rounded, and the umbilical wall nearly vertical. The lateral area bears bullae that begin on the umbilical shoulder and decrease gradually toward the ventral shoulder. On one specimen (Pl. 36, figs. 4, 5) the bullae are rather robust and widely spaced, there being approximately four per half volution. On the other specimen the bullae are narrower, not as robust, and there are approximately six bullae per half volution. Both Mojsisovics (1886) and Spath (1934) have emphasized the exceedingly variable character of this species. The two specimens recorded here can be compared favorably with one or more of the specimens illustrated by Mojsisovics (1886: pl. 1). The species *O. canadensis*, described by Tozer (1961a: 73) from Ellesmere Island, is also closely

related to *Olenekites spiniplicatus*, differing mainly in the subtabulate character of the venter on the later whorls.

Occurrence. Uppermost member of Thaynes Formation, Hammond Creek, Bear River Range, southeast Idaho.

Repository. MCZ 9482 (Pl. 36, figs. 3, 4), MCZ 9476 (Pl. 36, figs. 5, 6).

Genus *Eukashmirites* n. gen.

Type species, *Kashmirites acutangulatus* Welter, 1922: 125, pl. 9, figs. 9–12

The genus *Kashmirites* was introduced by Diener (1913: 33) for the "group of *Celtites subrectangularis* Waagen or *Celtites armatus* Waagen from the Ceratite Formation of the Salt Range." Diener at that time was dealing with a Scythian fauna from Kashmir. He had within his Kashmir fauna fragmentary specimens which he felt belonged to the *Celtites* of Waagen described from the Salt Range. This new generic name was introduced for these Salt Range and Himalayan species as they no longer could be accommodated in the genus *Celtites* as redefined by Mojsisovics (1893). In this revision it is quite apparent that Diener overlooked the genus *Pseudoceltites* Hyatt (1900)—type species *Celtites multiplicatus* Waagen. In the discussion of the genus *Pseudoceltites* it has already been pointed out that *Celtites armatus* (the type of *Kashmirites*, so designated by Diener, 1915: 137) is a synonym of *Celtites multiplicatus*. There is still, however, a need for separation of the group of ammonoids with subquadrate whorl sections, lateral ribs, occasional nodes which cross the venter, and a simple two lobed suture. Both Diener (1913) and Spath (1934) looked upon *Kashmirites blaschkei* Diener as a typical species. As noted by Diener (1913), the Kashmir specimens of *blaschkei* and related species are poorly preserved and fragmentary. Because of this I select Welter's Timor species *acutangulatus* as the type species of this new genus.

Eukashmirites is fairly well represented in the mid-Scythian zones of the Himalayas and Timor. In the late Scythian *Prohungarites* Zone it is represented by only two species, both from the Mangyshlak Peninsula in southern U.S.S.R.

Eukashmirites subdimorphus (Kiparisova)

Kashmirites subdimorphus Kiparisova, 1947: 148, pl. 33, figs. 3–5, text-figs. 40, 41; Astakhova, 1960a: 140.

The overall shell morphology of this species is very much like that of the type species—*E. acutangulatus*—from Timor except the whorls tend to be broader on the adoral volutions. The other species of this genus, *E. contortus* Astakhova, also known only from the Mangyshlak Peninsula, is a much more compressed form with slightly sinuous ribs on the adoral whorls.

Occurrence.—Scythian formation of Mangyshlak Peninsula but Kiparisova (1947) gives no precise horizon. Astakhova (1960b: 150) lists the species from her *Tirolites* Zone.

Eukashmirites contortus (Astakhova)

Kashmirites contortus Astakhova, 1960a: 139, pl. 33, fig. 5, text-fig. 7.

This species is also quite similar to the type species—*acutangulatus*—but much more compressed in its whorl section; the lateral ribs also are sinuous on the adoral whorls. The sample of this species available to Astakhova and to Kiparisova when she described *E. subdimorphus* was very small. It is conceivable that a large sample would show these two species to be synonyms.

Occurrence. Tirolites Zone of Astakhova, Mangyshlak Peninsula.

Genus *Anakashmirites* Spath, 1930

Type species, *Danubites nivalis* Diener, 1897

Species of this genus are known mainly from the mid-Scythian *Owenites* Zone. The only records of this genus are fragmentary and specifically indeterminate forms from the Narmia Member of the Mianwali Formation in the Surghar Range of West

Pakistan (Kummel, 1966). These specimens in conch form and ornamentation are very much like the species from the *Owenites* Zone but the suture is distinctly more advanced.

Superfamily CERATITACEAE Mojsisovics, 1879

Family TIROLITIDAE Mojsisovics, 1882

Genus *Tirolites* Mojsisovics, 1879

Type species, *Tirolites idrianus* Hauer, 1865

As with most genera of ornamented ammonites, the genus *Tirolites* includes a more than generous number of species. The great majority of these species were established for forms from the Werfen Formation of the Alps and Dalmatia. Mojsisovics in his classic monograph on "Die Cephalopoden der mediterranen Triasprovinz" (1882) recognized 14 species of *Tirolites*. The ammonites of the Werfen Formation were monographed by Kittl (1903), who recognized 40 species of *Tirolites* and three subgenera! Most subsequent authors (e.g. Smith, 1932; Spath, 1934) recognized that many (or most) of Kittl's species were very closely allied or identical, yet continued to recognize all the species—I presume as a matter of convenience.

I have had the opportunity of studying the Werfen Formation collection described by Kittl (1903), in the Natural History Museum, Vienna. All the specimens figured by Kittl (1903) were photographed, and measurements were made of all specimens sufficiently well preserved. It should be remarked here that Kittl's monograph is profusely illustrated by line drawings, and that in effect Kittl illustrated nearly every specimen of fair to good preservation. Most of the unfigured paratypes and topotypes are very poorly preserved specimens. No satisfactory photographic illustrations of the Werfen Formation *Tirolites* exist; for this reason the more important types of Kittl's study are reproduced here. Study of these illustrations first of all clearly shows the relatively poor preservation of most of the specimens, particularly since these figured forms are the very best specimens in the collection.

Tubercles on the ventro-lateral shoulder form the basic ornamentation pattern for *Tirolites*. Very often there are radial or prosiradiate ribs that extend from the tubercles dorsally along the flanks for variable distances. Study of the hundreds of specimens in the Kittl collection soon gives one the impression that they represent one continuous gradational series. Mojsisovics (1882) recognized two primary groups within the genus *Tirolites*, the Spinosi with ornamented inner whorls and the Seminudi with smooth inner whorls. Of the 14 species of *Tirolites* that Mojsisovics (1882) recognized from the Werfen Formation, 7 were assigned to the Spinosi, and 7 to the Seminudi. Kittl (1903) adopted the same two groups and recognized three additional groups as subgenera (*Hololobus*, *Svilajites*, *Bittnerites*).

Preservation of the Werfen Formation ammonites is such that retention and exposure of the inner whorls is not the usual thing. There are likewise numerous transitions between the two groups, Spinosi and Seminudi, and between these and other genera. One is tempted to consider all of the tirolitids of the Werfen Formation as a complex, variable, single species group. This could very well be the case. At the same time, in a general way, the Seminudi seldom have ribs associated with the tubercles as do the Spinosi. Clearly as a matter of convenience and not because of any real understanding of the relationships, I recognize two major species of tirolitids from the Werfen Formation—*T. idrianus* (Seminudi) and *T. cassianus* (Spinosi).

The type specimen of *Tirolites* (*Svilajites*) *cingulatus* is poorly preserved. Spath (1934) raised this group to generic rank and this was accepted by Kummel (*in* Arkell, et al., 1957). Examination of the type specimen leads me to believe that at best this can be recognized only as a distinct species of *Tirolites*.

Tirolitoides prior (Kittl, 1903) was said to have umbilical nodes and a more ceratitic suture. The so-called umbilical nodes are no more than a reflection of poor preservation and the suture is no different from that of many other specimens figured by Kittl (1903).

The comprehensive interpretation of the Werfen Formation tirolitids creates special problems in assessing the relationships to species from other horizons and localities. In no other locality or formation are the tirolitids as abundantly represented as they are in the Werfen Formation. The other species of *Tirolites* recognized here are discussed below, but in almost every case the species is known from very few specimens.

The *Subcolumbites* fauna of Albania has yielded three specimens of *Tirolites* (Arthaber, 1908, 1911) which are here considered to be *T. idrianus*. The upper Scythian formation of the Mangyshlak Peninsula has yielded *T. rossicus* Kiparisova (1947) and *T. impolitus* Astakhova (1960a). These two species were said to be associated with *T. cassianus* and *T. spinosus*. The Narmia Member of the Mianwali Formation in the Salt Range of West Pakistan has yielded a single indeterminate species of *Tirolites* (Kummel, 1966). The *Hedenstroemia* fauna of the Himalayas has yielded a single species—*T. injucundus* Krafft and Diener (1909). This is the oldest species of the genus recorded to date. A fragmentary specimen presumably from a *Subcolumbites* horizon in Kwangsi was assigned by Chao (1959) to *Tirolites* cf. *darwini*. Tirolitids are present in strata of Olenek age in the basin of the Kolyma River, Siberia (Popov, 1961).

Finally, in western North America there are several records of *Tirolites*. In fact the stratigraphic position of the *Tirolites* fauna as generally interpreted was established on the basis of the sequence of faunal zones in southeastern Idaho. In Paris Canyon, Smith (1932) discovered a small, poorly preserved fauna including three species of *Tirolites*, above his *Meekoceras* Zone and below his *Columbites* Zone. I have had several occasions to verify this sequence. These Paris Canyon species are very similar to the Spinosi of the Werfen Formation and are treated here as a single but distinct species—*T. harti* Smith. From the overlying *Columbites* Zone, Smith (1932) described a specimen as *T. illyricus*. Additional specimens of this species suggest its separation as a distinct form. The *Columbites* fauna contains two other species of *Tirolites* very different from the form Smith (1932) assigned to *T. illyricus*. Silberling (*in* Hose and Repenning, 1959: 2194) has recorded indeterminate species from the upper part of the Thaynes Formation in the Confusion Range of western Utah. These are recorded here as *T.* cf. *cassianus*.

It can be seen from this brief summary that species of *Tirolites* are now recognized throughout the upper half of the Scythian.

Tirolites idrianus (Hauer)

Plate 18, figures 1–6; Plate 66, figures 1–13; Plate 67, figures 1–9; Plate 68, figures 1–9; Plate 69, figures 1–10; Text-figure 39

Ceratites idrianus Hauer, 1865: 610, pl. 1, figs. 4, 5.

Tirolites idrianus.—Mojsisovics, 1879: 138; Mojsisovics, 1882: 67, pl. 1, fig. 1; Kittl, 1903: 36, pl. 5, figs. 8, 9; Arthaber, *in* Frech, 1906: pl. 34, fig. 14.

Tirolites seminudus Mojsisovics, 1882: 66, pl. 2, fig. 11; Kittl, 1903: 40, pl. 6, figs. 3–10, 17, 18; Arthaber, 1908: 275, pl. 11(1), fig. 9; Diener, 1915: 279; Spath, 1934: 375.

Tirolites seminudus var. *nudior* Kittl, 1903: 41, pl. 6, fig. 3; Spath, 1934: 375.

Tirolites seminudus var. *plicosus* Kittl, 1903: 41, pl. 6, figs. 5, 7; Diener, 1915: 279; Spath, 1934: 375.

Tirolites mercurii Mojsisovics, 1882: 68, pl. 1, fig. 9; Kittl, 1903: 38, pl. 5, figs. 10, 11, pl. 6, figs. 1, 2; Diener, 1915: 278; Spath, 1934: 377.

Tirolites paucispinatus Kittl, 1903: 39, pl. 6, fig. 11, pl. 7, figs. 4–6; Diener, 1915: 279.

Tirolites distans Kittl, 1903: 42, pl. 6, figs. 12–16, pl. 7, figs. 7, 8; Diener, 1915: 278; Spath, 1934: 375.

Tirolites quenstedti Mojsisovics, 1882: 66, pl. 2,

fig. 12; Kittl, 1903: 42, pl. 6, figs. 19, 20; Diener, 1915: 279.

Tirolites robustus Kittl, 1903: 43, pl. 7, figs. 9–11, pl. 8, fig. 1; Diener, 1915: 279; Spath, 1934: 377.

Tirolites dimidiatus Kittl, 1903: 44, pl. 8, fig. 15; Diener, 1915: 278; Spath, 1934: 377.

Tirolites stachei Kittl, 1903: 45, pl. 7, fig. 14; Diener, 1915: 280; Spath, 1934: 377.

Tirolites dinarus Mojsisovics, 1882: 74, pl. 2, fig. 9; Kittl, 1903: 45.

Tirolites hybridus Kittl, 1903: 46, pl. 8, fig. 2; Diener, 1915: 278.

Tirolites angustus Kittl, 1903: 47, pl. 7, fig. 12; Diener, 1915: 277; Spath, 1934: 377.

Tirolites subillyricus Kittl, 1903: 47, pl. 7, figs. 15, 16; Diener, 1915: 280.

Tirolites illyricus Mojsisovics, 1882: 68, pl. 2, fig 10; Kittl, 1903: 48, pl. 8, figs. 3, 4, 6–9; Arthaber, 1911: 250, pl. 22(6), fig. 4; Diener, 1915: 278; Spath, 1934: 373.

Tirolites repulsus Kittl, 1903: 49, pl. 8, figs. 5, 10, 11, 14; Diener, 1915: 279.

Tirolites rotiformis Kittl, 1903: 50, pl. 8, figs. 12, 13; Diener, 1915: 279.

Tirolites rectangularis Mojsisovics, 1882: 69, pl. 3, fig. 5; Kittl, 1903: 50, pl. 8, figs. 16, 17; Arthaber, 1911: 251, pl. 22(6), fig. 5; Diener, 1915: 279; Spath, 1934: 374.

Tirolites undulatus Kittl, 1903: 52, pl. 7, fig. 13; Diener, 1915: 280.

Tirolites heterophanus Kittl, 1903: 38, pl. 5, fig. 7.

The species *idrianus* includes all the "species" that had been included by Mojsisovics and Kittl in the Seminudi. Measurements of 122 specimens from the Werfen Formation of Muć, studied by Kittl, are given on Table 44 and plotted on Figure 39. There is clearly considerable variation in these conch parameters. The same is true of the pattern of ornamentation, the principal criterion used to differentiate species within this group. The illustrations given here should amply show that the number, spacing, etc., of the tubercles are highly variable. The sutures in the Seminudi were claimed to be entire, that is, goniatitic. This is not at all certain, as details of fine denticulations are most often not retained in the kind of preservation which characterizes the Werfen Formation fauna. The position of the lateral lobe is likewise highly variable.

Occurrence. Werfen Formation of Alps, Dalmatia, and associated regions. The three specimens of *Tirolites* recorded by Arthaber (1908, 1911) from the *Subcolumbites* fauna of Albania are included in this species.

Repository. All of the Kittl collection is in the Natural History Museum, Vienna. The specimens from the *Subcolumbites* fauna of Albania are in the Paleontological Institute, Vienna.

Tirolites cassianus (Quenstedt)

Plate 63, figures 1–9; Plate 64, figures 1–4; Plate 65, figures 1–9; Plate 70, figures 3–6, 11, 12; Text-figures 40, 41

Ceratites cassianus Quenstedt, 1849: 231, pl. 18, fig. 11; Hauer, 1865: 606, pl. 2, figs. 1, 2; Laube, 1869: 61, pl. 37, fig. 1.

Ammonites (Ceratites) cassianus,—Hauer, 1851: 6, pl. 2, fig. 5.

Tirolites cassianus,—Mojsisovics, 1882: 70, pl. 2, fig. 48, pl. 81, fig. 3; Tommasi, 1895: 69, pl. 4, fig. 15; Kittl, 1903: 54, pl. 9, figs. 4–6; Arthaber, 1906: pl. 34, fig. 15; Wittenburg, 1908: 285, pl. 40(5), fig. 19; Diener, 1915: 278; Diener, 1925: 80, pl. 12, fig. 1; Ogilvie-Gordon, 1927: 31, pl. 3, fig. 39; Kutassy, 1933: 674; Spath, 1934: 369, fig. 126; Leonardi, 1935: 90, pl. 6, figs. 5, 6; Kollárová-Andrusovová, 1961: 56, pl. 1, figs. 1, 3, 4.

Tirolites cassianus var. *tenuis* Mojsisovics, 1882: 71, pl. 2, figs. 4–6; Kittl, 1903: 55.

Tirolites cassianus var. *alpha* Kittl, 1903: 55, pl. 9, figs. 4, 5.

Tirolites angustilobatus Kittl, 1903: 54, pl. 9, figs. 1–3; Diener, 1915: 277; Spath, 1934: 370.

Tirolites angustilobatus var. *alpha* Kittl, 1903: 54, pl. 8, fig. 19.

Tirolites spinosus Mojsisovics, 1882: 70, pl. 1, fig. 10, pl. 2, figs. 1–3; Tommasi, 1895: 70, pl. 4, fig. 16; Kittl, 1903: 56, pl. 9, fig. 7; Diener, 1915: 279; Spath, 1934: 370; Leonardi, 1935: 91, pl. 6, figs. 7–9; Kollárová-Andrusovová, 1961: 57, pl. 1, figs. 2a, b.

Tirolites haueri Mojsisovics, 1882: 71, pl. 3, figs. 2–4; Kittl, 1903: 56, pl. 9, figs. 8–13; Diener, 1915: 278; Spath, 1934: 371.

Tirolites haueri var. *minor* Kittl, 1903: 58, pl. 10, figs. 1–3; Diener, 1915: 278.

Tirolites multispinatus Kittl, 1903: 58, pl. 11, fig. 9; Diener, 1915: 279.

Tirolites percostatus Kittl, 1903: 58, pl. 10, fig. 6; Diener, 1915: 279.

Tirolites turgidus Mojsisovics, 1882: 72, pl. 3, figs. 6, 7; Kittl, 1903: 59, pl. 10, figs. 7, 8; Diener, 1915: 280; Spath, 1934: 371.

Tirolites darwini Mojsisovics, 1882: 73, pl. 2,

TABLE 44. MEASUREMENTS OF SPECIMENS OF *TIROLITES IDRIANUS* (HAUER) FROM MUĆ IN DALMATIA STUDIED BY ERNST KITTL, 1903. ALL SPECIMENS ARE DEPOSITED IN THE NATURAL HISTORY MUSEUM, VIENNA.

	D	W	H	U	W/D	H/D	U/D		D	W	H	U	W/D	H/D	U/D
1.	66.0?	18.3	19.0	22.1	27.7?	28.8?	33.5?	25.	44.9	12.8	15.5	17.7	28.5	34.5	39.4
2.	57.3	?	22.7	19.0	?	39.6	33.2	26.	44.7	12.4	18.0	16.0	27.7	40.3	35.8
3.	55.5	18.5	19.9	22.7	33.3	35.9	40.9	27.	44.5	14.4	16.0	16.3	32.4	36.0	36.6
4.	53.7	17.8	18.8?	19.7?	33.1	35.0?	36.7?	28.	44.5	13.2	16.4	16.9	29.7	36.9	38.0
5.	52.6	?	20.7	19.3	?	39.4	36.7	29.	44.5	?	18.4	15.4	?	41.3	34.6
6.	52.5?	16.1	20.0	20.7	30.7?	38.1?	39.4	30.	44.4	?	15.3	17.8	?	34.5	40.1
7.	52.4	13.1	19.9	20.0	25.0	38.0	38.2	31.	44.3	12.1	16.7	19.4	27.3	37.7	43.8
8.	51.8	16.7	18.5	21.1	32.2	35.7	40.7	32.	44.2	13.0	17.3	16.0	29.4	39.1	36.2
9.	51.7	15.5	17.0	21.0?	30.0	32.9	40.6?	33.	44.1	12.3	16.2	17.5?	27.9	36.7	39.7?
10.	51.3	17.1	19.2	18.6	33.3	37.4	36.2	34.	44.1	10.4	9.2	19.1	23.6	20.9	43.3
11.	51.2	14.7	17.4	22.0	28.7	34.0	43.0	35.	43.7	12.6	15.2	17.3	28.8	34.8	39.6
12.	51.1	16.2	20.3	18.7?	31.7	39.7	36.6?	36.	43.4	10.1	15.7	17.0	23.3	36.2	39.2
13.	50.2	10.0±	18.5	19.0	19.9±	36.9	37.8	37.	43.3	14.3	16.8	16.6	33.0	38.8	38.3
14.	50.0	12.0	16.5	19.6	24.0	33.0	39.2	38.	43.3	10.0	14.5	18.3	23.1	33.5	42.3
15.	49.7	9.9	17.3	21.1	19.9	34.8	42.5	39.	43.2	14.0	17.3	15.4	32.4	40.0	35.6
16.	49.6	15.8	17.8	19.8	38.9	35.9	39.9	40.	43.2	11.2	12.8	21.8	25.9	29.6	50.5
17.	48.4	13.2	18.0	18.1	27.3	37.2	37.4	41.	43.2	8.5?	16.7	15.7	19.7?	38.7	36.3
18.	47.5	14.3	16.0	17.5?	30.1	33.7	36.8	42.	43.0	10.4?	16.8	15.7	24.2	39.1	36.5
19.	47.2	10.8	17.2	18.4	22.9	36.4	39.0	43.	43.0	?	17.1	15.2	?	39.8	35.3
20.	47.2	?	19.2	17.1	?	40.7	36.2	44.	42.7	14.1	15.8	16.2	33.0	37.0	37.9
21.	46.3	15.5?	17.3	17.7	33.5?	37.4	38.2	45.	42.7	13.3	15.7	16.0	31.1	36.8	37.5
22.	46.2	15.0	17.2	17.5	32.5	37.2	37.9	46.	42.6	13.7	15.3	17.0	32.2	35.9	39.9
23.	45.3	16.6	16.7	16.8?	36.6	36.9	37.1?	47.	42.6	13.1	14.7	16.0	30.8	34.5	37.6
24.	45.0	13.9	16.8	18.4	30.9	37.3	40.9	48.	42.4	13.4	14.6	17.7	31.6	34.4	41.7

1. Lectotype, *T. undulatus* Kittl (1903: pl. 7, fig. 13).
2. Lectotype, *T. stachei* Kittl (1903: pl. 7, fig. 14).
3. Plesiotype, *T. mercurii*,—Kittl (1903: pl. 6, fig. 2).
4. Unfigured paratype, *T. hybridus* Kittl (1903: 46).
5. Lectotype, *T. hybridus* Kittl (1903: pl. 8, fig. 2).
6, 16, 37, 45, 46, 48, 50, 64, 92. Unfigured paratypes, *T. robustus* Kittl (1903: 43).
7, 10, 12, 39, 63, 74, 86, 88. Unfigured paratypes, *T. angustus* Kittl (1903: 47).
8, 18, 75, 77, 85, 99, 102. Unfigured paratypes, *T. mercurii*,—Kittl (1903: 38).
9. Plesiotype, *T. mercurii*,—Kittl (1903: pl. 6, fig. 1).
11, 55, 61, 67, 70, 71, 76, 89, 90, 95, 103, 104, 105, 106, 110, 111, 115, 118, 121, 122. Unfigured specimens, *T. seminudus*,—Kittl (1903: 40).
13. Plesiotype, *T. quenstedti*,—Kittl (1903: pl. 6, fig. 19).
14. Plesiotype, *T. illyricus*,—Kittl (1903: pl. 8, fig. 4).
15. Plesiotype, *T. seminudus*,—Kittl (1903: pl. 6, fig. 3).
17, 87, 98. Unfigured specimens, *T. quenstedti*,—Kittl (1903: 42).
19. Plesiotype, *T. quenstedti*,—Kittl (1903: pl. 6, fig. 20).
20. Paralectotype, *T. distans* Kittl (1903: pl. 7, fig. 8).
21. Plesiotype, *T. mercurii*,—Kittl (1903: pl. 5, fig. 11).
22. Plesiotype, *T. illyricus*,—Kittl (1903: pl. 8, fig. 3).
23. Plesiotype, *T. mercurii*,—Kittl (1903: pl. 5, fig. 10).
24. Paralectotype, *T. distans* Kittl (1903: pl. 6, fig. 12).
25. Syntype, *T. subillyricus* Kittl (1903: pl. 7, fig. 15).
26, 30. Unfigured paratypes, *T. subillyricus* Kittl (1903: p. 47).
27. Paralectotype, *T. distans* Kittl (1903: pl. 6, fig. 14).
28. Plesiotype, *T. seminudus*,—Kittl (1903: pl. 6, fig. 4).
29, 83, 113. Unfigured paratypes, *T. paucispinatus* Kittl (1903: 39).
31, 36, 60, 65, 66, 81. Unfigured specimens, *T. illyricus*,—Kittl (1903: 48).
32. Plesiotype, *T. illyricus*,—Kittl (1903: pl. 8, fig. 8).
33, 53, 69, 73, 94, 101. Unfigured paratypes, *T. distans* Kittl (1903: 42).
34. Plesiotype, *T. rectangularis*,—Kittl (1903: pl. 8, fig. 16).
35. Plesiotype, *T. seminudus*,—Kittl (1903: pl. 6, fig. 7).
38. Figured type, *T. repulsus* Kittl (1903: pl. 8, fig. 11).
40. Figured type, *T. rotiformis* Kittl (1903: pl. 8, fig. 12).
41. Plesiotype, *T. illyricus*,—Kittl (1903: pl. 8, fig. 7).
42. Plesiotype, *T. seminudus*,—Kittl (1903: pl. 6, fig. 8).
43. Plesiotype, *T. seminudus*,—Kittl (1903: pl. 6, fig. 18).
44. Figured type, *T. repulsus* Kittl (1903: pl. 8, fig. 5).
47, 108. Unfigured paratypes, *T. rotiformis* Kittl (1903: 50).

TABLE 44. *Continued.*

	D	W	H	U	W/D	H/D	U/D		D	W	H	U	W/D	H/D	U/D
49.	42.4	12.6	15.1	17.9	29.7	35.6	42.2	86.	38.0	11.7	14.4	14.6	30.8	37.9	38.4
50.	42.3	12.8	17.0	15.3	30.3	40.2	36.2	87.	38.0	8.2?	14.7	14.5?	21.6?	38.7	38.2?
51.	42.3	11.2	15.1	14.8	26.5	35.7	35.0	88.	37.8	8.4?	15.3	13.0	22.2?	40.5	34.4
52.	42.2	14.6	16.2	16.3	34.6	38.4	38.6	89.	37.5	12.0	12.8	15.4	32.0	34.1	41.1
53.	42.1	13.2	14.5	17.1	31.4	34.4	40.6	90.	37.3	10.0	13.3	16.0	26.8	35.7	42.9
54.	42.1	12.0	14.2	17.1	28.5	33.7	40.6	91.	37.0?	11.6	13.8	14.0?	31.4?	37.3?	37.8?
55.	42.0	10.2	15.0	16.1	24.3	35.7	38.3	92.	37.0	11.5	14.5	13.6	31.1	39.2	36.8
56.	41.7	13.8	16.5	14.5	33.1	39.6	34.8	93.	37.0?	11.3	12.6	12.2?	30.5?	34.1?	33.0?
57.	41.5	11.7?	16.1	15.4	28.2?	38.8	37.1	94.	37.0	10.2	13.6	13.3	27.6	36.8	35.9
58.	41.4	15.6	16.8	14.6	37.7	40.6	35.3	95.	36.3	11.5	12.7	14.7	31.7	35.0	40.5
59.	41.4	13.2	15.2	17.0	31.9	36.7	41.1	96.	36.0	8.9	14.0	14.4	24.7	38.9	40.0
60.	41.4	10.5	14.6	17.6	25.4	35.3	42.5	97.	35.7	10.7	12.3	14.8	30.0	34.5	41.5
61.	41.2	12.1?	14.1	16.1	29.4?	34.2	39.1	98.	35.7	9.8	12.0	14.4	27.5	33.6	40.3
62.	41.0	10.8	15.1	17.1	26.3	36.8	41.7	99.	35.6	12.0	14.1	11.7	33.7	39.6	32.9
63.	40.8	13.8	14.7?	15.3?	33.8	36.0?	37.5?	100.	35.6?	11.8	13.0	14.8	33.1?	36.5?	41.6
64.	40.7	13.0	14.0	15.8	31.9	34.4	38.8	101.	35.5	9.4	13.1	14.4	26.5	36.9	40.6
65.	40.5	11.6	9.2	16.1	28.6	22.7	39.8	102.	35.4	10.8?	13.6	14.0	30.5?	38.4	39.5
66.	40.5	11.3	13.8	18.2	27.9	34.1	44.9	103.	35.4	10.5	12.7	12.8	29.7	35.9	36.2
67.	40.5	8.8?	13.5	17.0	21.7	33.3	42.0	104.	35.2	11.3	13.0	13.3	32.1	36.9	37.8
68.	40.1	12.8	14.7	14.6	31.9	36.7	36.4	105.	35.2	9.3	12.6	13.8	26.4	35.8	39.2
69.	40.1	11.9	14.2	16.2	29.7	29.7	40.4	106.	35.0	8.7?	13.1	13.3	24.9?	37.4	38.0
70.	40.1	11.6	13.5	15.5	28.9	33.7	38.7	107.	34.9	8.7?	12.5	13.2	24.9?	35.8	37.8
71.	40.0	12.6	14.2	16.5	31.5	35.5	41.3	108.	34.8	9.5	11.1	15.2	27.3	31.9	43.7
72.	40.0	12.1	15.0	14.3	30.3	37.5	36.8	109.	34.6	10.7	10.5	15.5?	30.9	30.3	44.8?
73.	39.8	11.7	14.1	15.2	29.4	35.4	38.2	110.	34.1	9.6	12.5	13.4	28.2	36.7	39.3
74.	39.7	12.8	15.0	14.4	32.2	37.8	36.3	111.	34.0	10.1	12.6	13.2	29.7	37.1	38.8
75.	39.6	18.8	15.0?	14.5	47.5	37.9	36.6	112.	33.9	9.8	11.8	13.0	28.9	34.8	38.3
76.	39.4	12.3	14.5	15.7	31.2	36.8	39.8	113.	32.3	8.5	11.2	12.7	26.3	34.7	39.3
77.	39.2	14.0	15.0?	14.0?	35.7	38.3?	35.7?	114.	31.8	8.6	11.4	12.8	27.0	35.8	40.3
78.	39.0	13.8	14.1	14.7	35.4	36.2	37.7	115.	31.2	8.8	11.5	11.8	28.2	36.9	37.8
79.	38.8	?	16.1	13.6	?	41.5	35.1	116.	30.8	7.8?	9.6	8.7	25.3?	31.2	28.2
80.	38.6	10.2	13.2	16.2	26.4	34.2	42.0	117.	30.5?	7.5?	11.6	11.4	24.6?	38.0?	37.4?
81.	38.5	9.1	12.5?	17.4	23.6	32.5?	45.2	118.	30.0	7.9	11.2	11.3	26.3	37.3	37.7
82.	38.5	?	16.5	13.7	?	42.9	35.6	119.	28.7	8.9	9.3	12.3	31.0	32.4	42.9
83.	38.2	11.5	13.3	14.6	30.1	34.8	38.2	120.	28.6	7.5	9.0	12.7	26.2	31.5	44.4
84.	38.2	11.4	13.8	14.7	29.8	36.1	38.5	121.	28.4	8.5	11.1	9.9	29.9	39.1	34.9
85.	38.0	13.1	15.3	13.4	34.5	40.3	35.3	122.	21.7	6.3	7.7	7.7	29.0	35.5	35.5

49. Unfigured paratype, *T. rectangularis*,—Kittl (1903: 50).
51. Figured type, *T. paucispinatus* Kittl (1903: pl. 6, fig. 11).
52, 78. Unfigured paratypes, *T. undulatus* Kittl (1903: 52).
54. Figured type, *T. paucispinatus* Kittl (1903: pl. 7, fig. 6).
56. Holotype, *T. angustus* Kittl (1903: pl. 7, fig. 12).
57. Figured type, *T. paucispinatus* Kittl (1903: pl. 7, fig. 4).
58. Lectotype, *T. robustus* Kittl (1903: pl. 7, fig. 9).
59. Plesiotype, *T. rectangularis*,—Kittl (1903: pl. 8, fig. 17).
62. Plesiotype, *T. quenstedti*,—Kittl (1903: pl. 6, fig. 20).
68. Paralectotype, *T. distans* Kittl (1903: pl. 6, fig. 13).
72. Plesiotype, *T. seminudus*,—Kittl (1903: pl. 6, fig. 5).
79. Paralectotype, *T. distans* Kittl (1903: pl. 7, fig. 7).
80. Figured type, *T. repulsus* Kittl (1903: pl. 8, fig. 10).
82. Figured type, *T. paucispinatus* Kittl (1903: pl. 7, fig. 5).
84. Plesiotype, *T. illyricus*,—Kittl (1903: pl. 8, fig. 6).
91. Lectotype, *T. distans* Kittl (1903: pl. 6, fig. 15).
93. Paralectotype, *T. distans* Kittl (1903: pl. 6, fig. 16).
96. Plesiotype, *T. illyricus*,—Kittl (1903: pl. 8, fig. 9).
97, 109, 119. Unfigured paratypes, *T. repulsus* Kittl (1903: 49).
100. Paralectotype, *T. robustus* Kittl (1903: pl. 7, fig. 11).
107. Syntype, *T. subillyricus* Kittl (1903: pl. 7, fig. 16).
112. Plesiotype, *T. seminudus*,—Kittl (1903: pl. 6, fig. 9).
114. Plesiotype, *T. seminudus*,—Kittl (1903: pl. 6, fig. 17).
116. Figured type, *T. rotiformis* Kittl (1903: pl. 8, fig. 13).
117. Plesiotype, *T. seminudus*,—Kittl (1903: pl. 6, fig. 10).
120. Figured type, *T. repulsus* Kittl (1903: pl. 8, fig. 14).

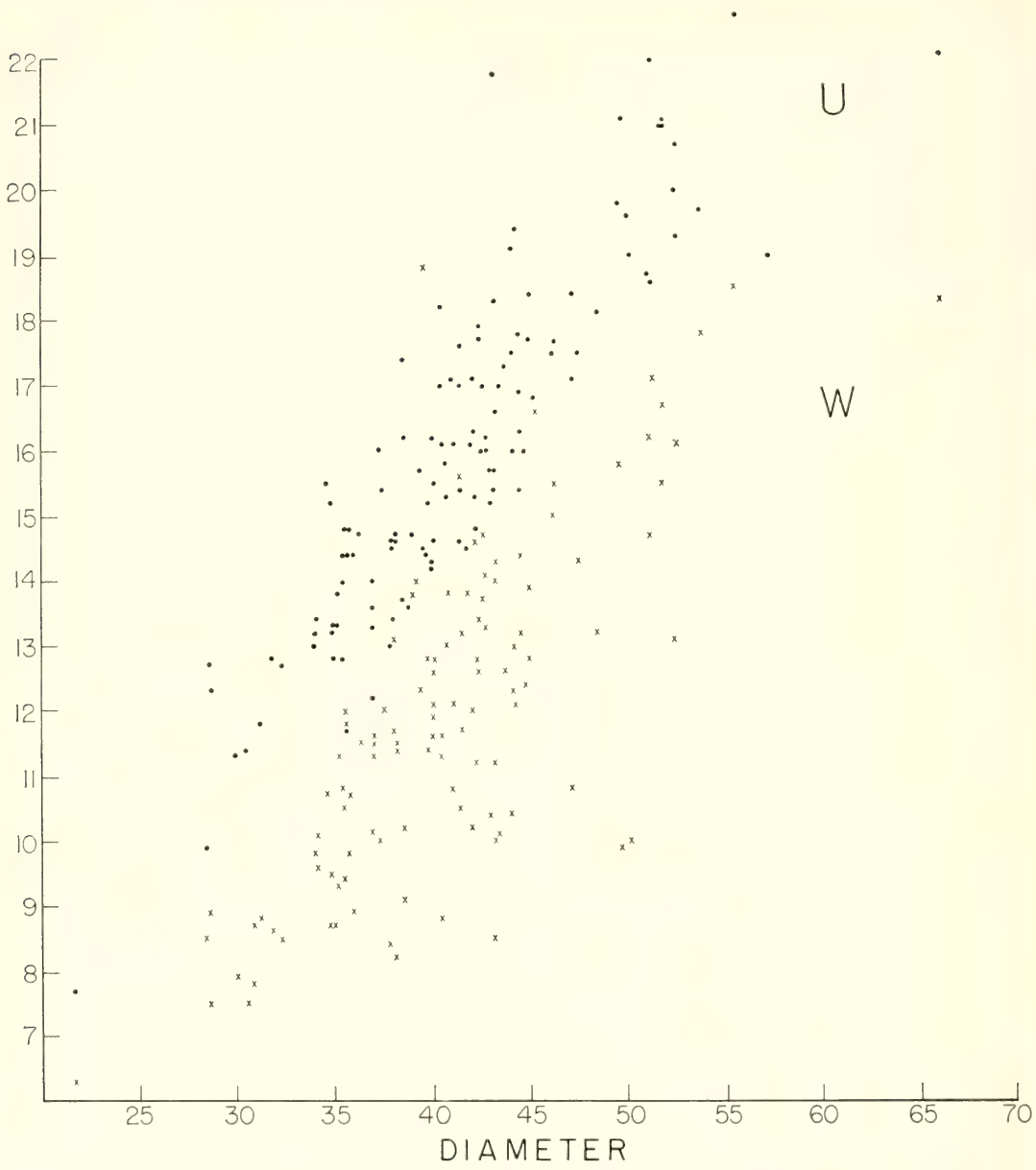

Figure 39. Variation in whorl width (W) and umbilical diameter (U) in *Tirolites idrianus*,—Mojsisovics, from Werfen Formation of Muć, Dalmatia. The data on this graph are from Table 44.

fig. 13, pl. 3, fig. 1; Kittl, 1903: 60, pl. 10, figs. 4, 5, 11, pl. 11, figs. 1–3, 7; Diener, 1915: 278; Patte, 1922: 54, pl. 3, fig. 16; Spath, 1934: 372.

Tirolites darwini var. *cinctus* Kittl, 1903: 61, pl. 10, fig. 4, pl. 11, fig. 3; Spath, 1934: 372.

Tirolites darwini var. *reminiscens* Kittl, 1903: 61, pl. 10, fig. 5; Spath, 1934: 372.

Tirolites darwini var. *modestus* Kittl, 1903: 61, pl. 11, fig. 7; Spath, 1934: 372.

Tirolites darwini var. *costatus* Kittl, 1903: 62, pl. 11, fig. 2; Spath, 1934: 372.

Tirolites darwini var. *abbrevians* Kittl, 1903: 62; Spath, 1934: 372.

Tirolites spinosior Kittl, 1903: 62, pl. 11, fig. 5; Diener, 1915: 279.

Ceratites smiriagini Auerbach, 1871: 50, pl. 4, figs. 9–11.

Tirolites smiriagini,—Mojsisovics, 1882: 73, pl. 81, figs. 1, 2; Kittl, 1903: 63, pl. 11, fig. 6;

Diener, 1915: 279; Spath, 1934: 372.
Tirolites kerneri Kittl, 1903: 64, pl. 11, fig. 8; Diener, 1915: 278; Spath, 1934: 373.
Tirolites toulai Kittl, 1903: 64, pl. 11, figs. 11, 12; Diener, 1915: 280; Spath, 1934: 358, 379.
Tirolites (Svilajites) tietzei Kittl, 1903: 66, pl. 10, fig. 9; Diener, 1915: 281.
Ceratites (Paraceratites) prior Kittl, 1903: 29, pl. 11, figs. 4, 13.
Xenodiscus prior,—Diener, 1915: 314.
Tirolitoides prior,—Spath, 1934: 378, fig. 127; Kummel, *in* Arkell, et al., 1957: L147, fig. 180, 5.
Tirolites bispinatus Ganev, 1966: 25, pl. 1, fig. 5.

The species *cassianus* includes all the species that had been included by Mojsisovics and Kittl in the Spinosi. In general the representatives of this species have ribs associated with the ventrolateral tubercles. There are, however, gradational forms to *idrianus*. Measurements of 31 specimens from the Werfen Formation of Muć, Dalmatia, are given on Table 45 and plotted on Figure 41. Very few specimens of this species in the Kittl collection that were not figured are sufficiently well preserved to yield useful measurements; this accounts for the fewer measurements of this species than of *idrianus*. The many species of this group were differentiated on differences in ornamentation and suture. There appears, however, to be complete transition among the various so-called species in these and other characters.

The types of *Tirolitoides prior* owe their umbilical tubercles to preservation. The suture likewise is no different from that of several other tirolitids (Fig. 40B).

The type specimen of *Tirolites (Svilajites) tietzei* Kittl, with its ventral cross-ribs, is no more than a typical tirolitid. Many other specimens have similar cross-ribs on the venter though generally not as well developed as in the type specimen of *tietzei*.

The binodal aspect of *Tirolites bispinatus* Ganev (1966) is apparently due to the crushed nature of the specimen. There is a plaster cast of the holotype, and only specimen, in the Museum of Comparative Zoology.

Occurrence. Werfen Formation of the Alps, Dalmatia and the associated regions. Also reported from eastern Bulgaria, from southern U.S.S.R. at Bogdo, Mangyshlak Peninsula, and Tuarkyr.

Repository. The specimens studied here are from the Kittl (1903) collection which is in the Natural History Museum, Vienna.

Tirolites cingulatus Kittl
Plate 70, figures 8–9

Tirolites (Svilajites) cingulatus Kittl, 1903: 65, pl. 8, fig. 18; Diener, 1915: 280.
Svilajites cingulatus,—Spath, 1934: 380, fig. 129; Kummel, *in* Arkell, et al., 1957: L147, fig. 180, 1.

The type species of *Svilajites* is *cingulatus*. The type specimen measures 37.3 mm in diameter, 10.3 mm for the width of the adoral whorl, 14.6 mm for the height, and the umbilicus is 13.2 mm in diameter. It is really only on the venter and one side of the last half volution that the shape and pattern of ornament are of at least fair preservation. The prior volutions and the opposite side from that shown on Plate 70, figure 9, are completely destroyed by weathering. The adoral half volution has two radial ribs extending from the umbilical shoulder to the ventral shoulder. These ribs presumably cross the venter, but on the type specimen this region of the venter is broken. An unfigured paratype in the collection of the Natural History Museum, Vienna, is weathered and poorly preserved but does show the ribs crossing the venter.

The second species that Kittl assigned to his subgenus *Svilajites* is *tietzei*, and it is illustrated here on Plate 70, figures 11, 12. The type specimen measures 41.7 mm in diameter, 12.8 mm for the width of the adoral whorl, 16.6 mm for the height, and the umbilicus is 16.9 mm in diameter. This is a typical tirolitid of much better preservation than the type specimen of *cingulatus*. There are broad folds extending across the venter from the ventro-lateral nodes. There is an indication that these cross folds decrease in prominence adorally. The general features of this species and especially the folds across the venter are to be seen

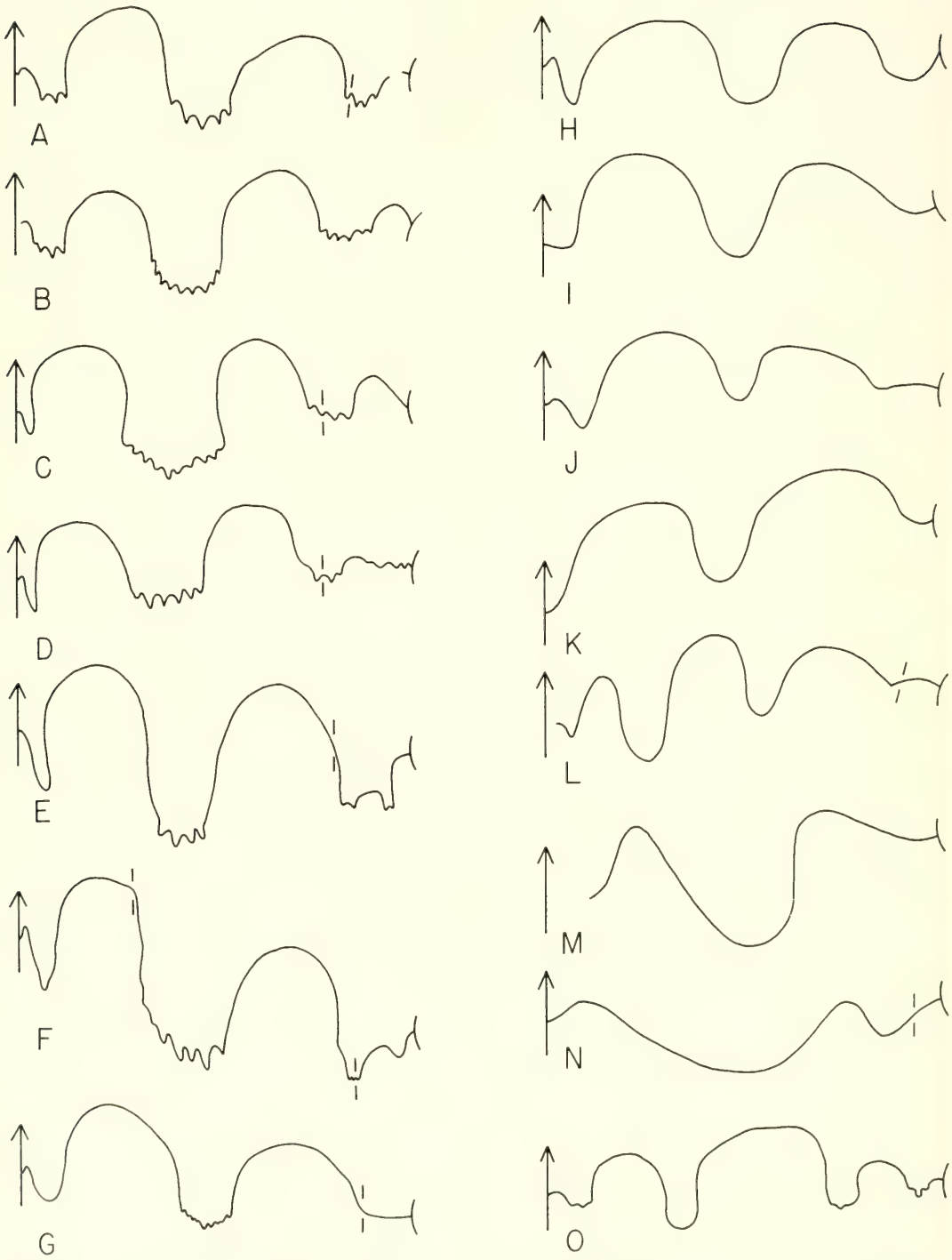

Figure 40. Diagrammatic representation of the suture of: A, *Tirolites toulai* Kittl (1903: pl. 11, fig. 11), at a diameter of 45 mm; B, paratype *Tirolitoides prior* (Kittl, 1903: pl. 11, fig. 4b), at a diameter of 35 mm; C, *Tirolites impolitus* Astakhova (1960a: fig. 16); D, *Tirolites elegans* Astakhova (1960a: fig. 15); E, *Tirolites* cf. *cassianus* (Pl. 34, figs. 9, 10), at a whorl

TABLE 45. MEASUREMENTS OF SPECIMENS OF *TIROLITES CASSIANUS* (QUENSTEDT) FROM MUĆ IN DALMATIA STUDIED BY ERNST KITTL, 1903. ALL SPECIMENS ARE DEPOSITED IN THE NATURAL HISTORY MUSEUM, VIENNA.

	D	W	H	U	W/D	H/D	U/D		D	W	H	U	W/D	H/D	U/D
1.	85.0	21.5	28.5	37.2	26.7	33.5	43.8	17.	49.8	13.1	17.7	21.0	26.3	35.5	42.2
2.	76.0	16.6	26.5	34.0	21.8	34.9	44.7	18.	49.0	15.3	15.6	21.2	31.2	31.8	43.3
3.	66.0	16.8	22.9	28.2	25.5	34.7	42.7	19.	49.0	17.0	17.3	20.7	34.7	35.3	42.2
4.	65.0	17.2?	22.5	27.2	26.5?	34.6	41.8	20.	47.7?	?	15.2	22.1	?	31.9?	46.3
5.	59.5	14.8	21.2	26.0	24.9	35.6	43.7	21.	47.1	?	16.3	20.6	?	34.6	43.7
6.	59.3	19.3	20.7	24.2	32.5	34.9	40.8	22.	46.7	15.7	17.8	17.7	33.6	38.1	37.9
7.	58.7	20.0	20.8	25.0	34.1	35.4	42.6	23.	46.6	?	9.1?	22.8	?	19.5	48.9
8.	57.0	15.5?	20.1	22.4	27.2?	35.3	39.3	24.	46.2?	13.0	15.6	20.7	28.1?	33.8?	44.8?
9.	56.6	15.3	15.4	21.7	27.0	27.2	38.3	25.	45.0	11.3	14.2	20.9	25.1	31.6	46.4
10.	56.3	17.7	19.1	24.0	31.4	33.9	42.6	26.	43.6	11.0?	15.7	19.5	25.2?	36.0	44.7
11.	55.7	14.7	19.3	23.7	26.4	34.6	42.5	27.	43.5	15.2	15.6	17.2	34.9	35.9	39.5
12.	55.0	17.0	18.6	23.2	30.9	33.8	42.2	28.	42.2	?	9.6	18.0	?	22.7	42.7
13.	51.0	17.2	17.3	22.8	33.7	33.9	44.7	29.	40.5	10.3?	13.7	18.4	25.4?	33.8	45.4
14.	50.4	16.3	17.0	20.7	32.3	33.7	41.1	30.	38.4	12.4	12.8	17.4	32.3	33.3	45.3
15.	50.4	13.5	17.2	20.7	26.8	34.1	41.1	31.	36.6	10.1	12.9	14.1	27.6	35.2	38.5
16.	50.2	10.2	17.6	21.3	20.3	35.1	42.4								

1. Plesiotype, *T. darwini*,—Kittl (1903: pl. 10, fig. 11).
2. Lectotype, *T. spinosior* Kittl (1903: pl. 11, fig. 5).
3. Plesiotype, *T. darwini*,—Kittl (1903: pl. 11, fig. 1).
4. Plesiotype, *T. darwini* var. *costatus* Kittl (1903: pl. 11, fig. 2).
5. Syntype, *T. toulai* Kittl (1903: pl. 11, fig. 11).
6. Pleisotype, *T. haueri*,—Kittl (1903: pl. 9, fig. 10).
7. Plesiotype, *T. turgidus*,—Kittl (1903: pl. 10, fig. 8).
8. Plesiotype, *T. haueri*,—Kittl (1903: pl. 9, fig. 9).
9. Lectotype, *T. percostatus* Kittl (1903: pl. 10, fig. 6).
10, 12, 14, 15. Unfigured specimens, *T. haueri*,—Kittl (1903: 56).
11. Plesiotype, *T. spinosus*,—Kittl (1903: pl. 9, fig. 7).
13. Plesiotype, *T. haueri*,—Kittl (1903: pl. 9, fig. 13).
16. Plesiotype, *T. cassianus*,—Kittl (1903: pl. 9, fig. 4).
17. Figured specimen, *T. darwini* var. *modestus* Kittl (1903: pl. 11, fig. 7).
18. Plesiotype, *T. haueri*,—Kittl (1903: pl. 9, fig. 8).
19. Plesiotype, *T. haueri*,—Kittl (1903: pl. 9, fig. 12).
20. Plesiotype, *T. smiriagini*,—Kittl (1903: pl. 11, fig. 6).
21. Lectotype, *T. angustilobatus* Kittl (1903: pl. 9, fig. 3).
22. Figured specimen, *T. haueri* var. *minor* Kittl (1903: pl. 10, fig. 1).
23. Figured specimen, *T. angustilobatus* var. *alpha* Kittl (1903: pl. 9, fig. 1).
24. Figured specimen, *T. darwini* var. *reminiscens* Kittl (1903: pl. 10, fig. 5).
25. Figured specimen, *T. darwini* var. *cinctus* Kittl (1903: pl. 10, fig. 4).
26. Plesiotype, *T. cassianus*,—Kittl (1903: pl. 9, fig. 6).
27. Figured specimen, *T. haueri* var. *minor* Kittl (1903: pl. 10, fig. 3).
28. Plesiotype, *T. cassianus*,—Kittl (1903: pl. 9, fig. 5).
29. Figured specimen, *T. angustilobatus* var. *alpha* Kittl (1903: pl. 8, fig. 19).
30. Figured specimen, *T. haueri* var. *minor* Kittl (1903: pl. 10, fig. 2).
31. Figured specimen, *T. darwini* var. *cinctus* Kittl (1903: pl. 11, fig. 3).

←

height of 19 mm; F, *Tirolites* sp. indet. II (Pl. 55, figs. 4, 5), at a whorl height of 14 mm (MCZ 9502); G, holotype *Tirolites astakhovi* n. sp. (Pl. 55, figs. 1, 2), at a diameter of 45 mm (USNM 153081); H, *Dinarites dalmatinus*,—Kittl (1903: pl. 2, fig. 4), at a diameter of approximately 40 mm; I, *Dinarites dalmatinus*,—Kittl (1903: pl. 3, fig. 3), at a diameter of approximately 30 mm; J, *Dinarites dalmatinus*,—Kittl (1903: pl. 2, fig. 2), at a diameter of approximately 26 mm; K, holotype *Hololobus monoptychus* (Kittl, 1903: pl. 4, fig. 9), at a diameter of approximately 40 mm; L, holotype *Pseudokymatites svilajanus* Kittl (1903: pl. 4, fig. 3), at a diameter of approximately 40 mm; M, *Dinarites undatus* Astakhova (1960a: fig. 17), at a diameter of approximately 25 mm; N, *Dinarites liatsikasi* Renz and Renz (1948: pl. 1, fig. 3c); O, *Doricranites bogdoanus* (Mojsisovics, 1882: pl. 80, fig. 4), at a diameter of approximately 80 mm.

Specimens of figures A, B, H, I, J, K, L from Werfen Formation, Dalmatia; of C, D, M from upper Scythian strata Mangyshlak Peninsula; of N, from *Subcolumbites* fauna of Chios; of O, from upper Scythian strata Mount Bogdo, southern Russia; E, Upper Thaynes Formation, Confusion Range, Utah; F, G, *Columbites* fauna southeastern Idaho.

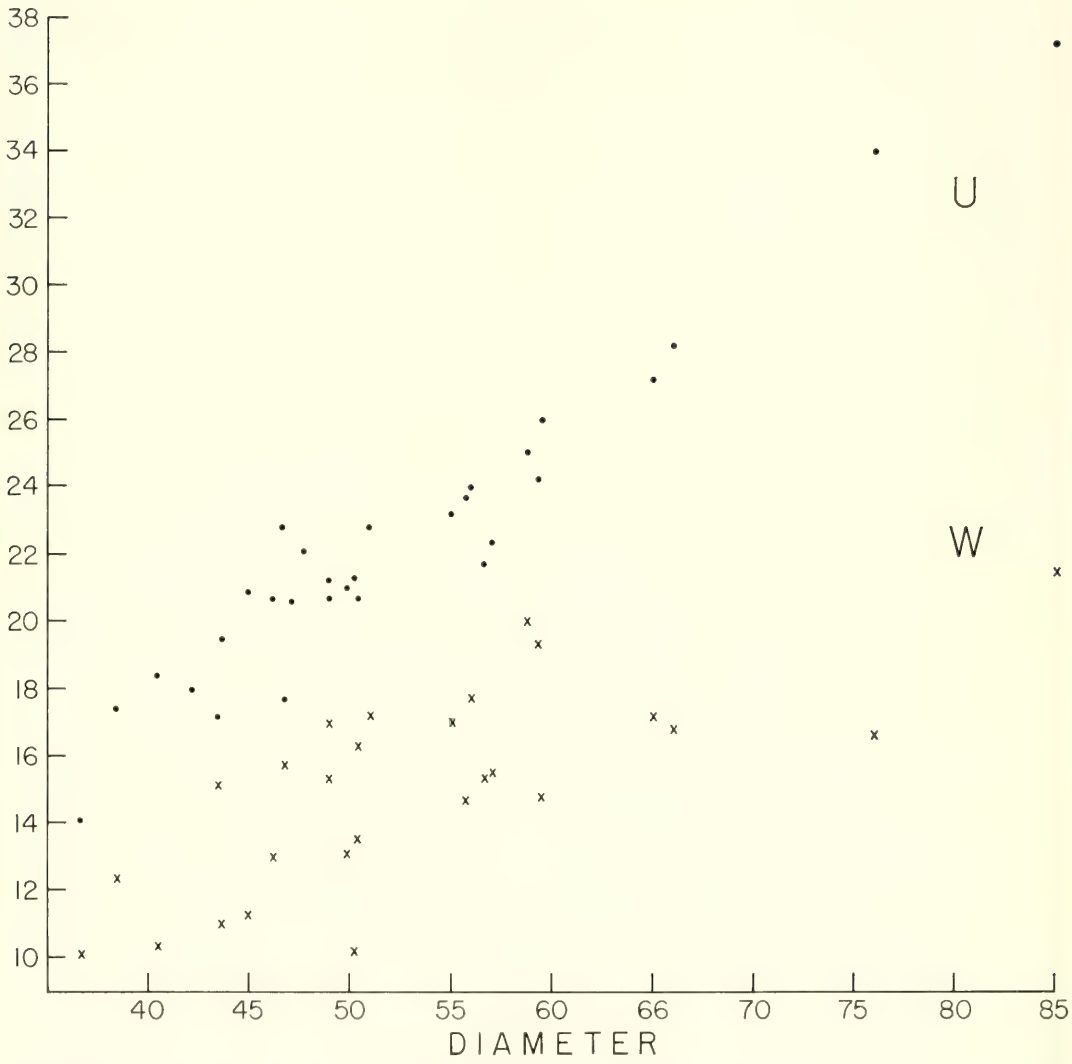

Figure 41. Variation in whorl width (W) and umbilical diameter (U) in *Tirolites cassianus* (Quenstedt), from the Werfen Formation of Muć, Dalmatia. The data on this graph are from Table 45.

in several of the so-called species of *Tirolites* of the Spinosi. The ventral ridges are related in some degree to the general prominence of the ventro-lateral nodes. The species *tietzei* belongs in the synonymy of *Tirolites cassianus*.

The species *cingulatus* is thus known from only two poorly preserved specimens. These appear to be distinct from the highly variable *Tirolites cassianus* at a specific level but not at a generic level as has been advocated.

Occurrence. Werfen Formation, Muć, Dalmatia.

Repository. Natural History Museum, Vienna.

Tirolites rossicus Kiparisova
Text-figure 40

Tirolites rossicus Kiparisova, 1947: 168, pl. 43, figs. 2, 3, pl. 44, fig. 2, text-fig. 66; Shevyrev and Shlezinger, 1960: 1418.

Tirolites elegans Astakhova, 1960a: 150, pl. 35, fig. 1; text-fig. 15.

A robust species that in its slightly

prosiradiate ribs on the inner whorls reminds one of the specimens assigned to *T.* cf. *cassianus* from the Thaynes Formation of the Confusion Range (Pl. 34, figs. 7–10). This species is clearly a member of the Spinosi and is said by Astakhova (1960a) to be associated with *T. cassianus* and *T. spinosus*. The suture of *T. elegans* Astakhova is illustrated on Figure 40D.

Occurrence. *Tirolites* Zone of Astakhova (1960a), Mangyshlak Peninsula.

Tirolites impolitus Astakhova
Text-figure 40

Tirolites impolitus Astakhova, 1960a: 151, pl. 35, fig. 5, text-fig. 16.

This species comes from a horizon approximately 150 m above that which yielded *T. rossicus*. It differs from that species primarily in having more prominent ribs and nodes. Too few data are available as yet on the Mangyshlak fauna. At the moment it seems best to accept this species; a great deal more collecting and study are needed of these forms. The suture is shown on Figure 40C.

Occurrence. *Tirolites* Zone of Astakhova (1960a), Mangyshlak Peninsula.

Tirolites morpheos (Popov)

Columbites morpheos Popov, 1961, p. 28, pl. 13, fig. 8.

Popov assigned this species (based on two specimens) to the genus *Columbites* on the strength of an apparent similarity of the suture to that of *Columbites parisianus*. Popov, however, was not aware of the tremendous variation that is present in the suture of *Columbites parisianus* (Fig. 22). This suture is quite similar to that of *Tirolites* in basic plan. A more reliable indicator of genetic affinity is the ornamentational pattern. In this respect the species *morpheos* is clearly a tirolitid.

Popov (1961) described two other tirolitids from Siberia on the basis of single fragmentary and poorly preserved specimens. Both specimens were collected from alluvium in the basin of the Kolyma River, Siberia. These two species—*T.* ex gr. *cassianus*, Popov (1961: 29, pl. 13, fig. 7) and *T. gerbaensis* Popov (1961: 29, pl. 13, fig. 5)—because of poor preservation and lack of stratigraphic data are included in the list of unrecognizable species.

Occurrence. Olenek stage, basin of Kolyma River, Siberia.

Tirolites harti Smith
Plate 71, figures 1–7

Tirolites harti Smith, 1932: 83, pl. 57, figs. 9, 10.
Tirolites knighti Smith, 1932: 84, pl. 57, figs. 1–4.
Tirolites pealei Smith, 1932: 84, pl. 57, figs. 5–8.

Smith (1932) clearly recognized that the few fragmentary specimens of *Tirolites* he had from the *Tirolites* Zone in Paris Canyon were closely related to, if not conspecific with, various species of the Spinosi of the Werfen Formation. In this conclusion I am in complete agreement. However, along with Smith, I believe it best to keep these Idaho forms under a separate species name because the fragmentary specimens known to date do not allow any kind of critical analysis.

Occurrence. *Tirolites* Zone, Thaynes Formation, Paris Canyon, southeast Idaho.

Repository. Holotype, USNM 75022; *T. knighti*, holotype, USNM 75020a; paratype, USNM 75020b; *T. pealei*, holotype USNM 75021a; paratype, USNM 75021; topotypes MCZ 9641.

Tirolites smithi n. sp.
Plate 54, figures 1–5

Tirolites illyricus Mojsisovics, Smith, 1932: 84, pl. 49, figs. 12–16.

Smith (1932) had a single specimen from the *Columbites* fauna of Paris Canyon, southeast Idaho, that he assigned to Mojsisovics' species—*illyricus*. There is a general resemblance to *T. illyricus* as there is to many other closely similar Werfen Formation forms. The Idaho species, however, has a very different aspect. First of all, Smith's specimen has fine radial ribs

on the inner whorls, that decrease adorally; on the outer volution the ribs are gone and only sinuous growth lines are present with widely spaced tubercles at the ventral shoulders; the venter is highly vaulted. Two additional specimens have since been uncovered which are of special interest. There is first of all a small juvenile form (Pl. 54, figs. 4, 5) measuring 31.4 mm in diameter, 9.3 mm for the width of the adoral whorl, 11.2 mm for the height, and the umbilicus is 12.8 mm in diameter. The radial ribs on the inner whorls and the gradual adoral decrease in rib prominence are well displayed on this specimen. The ventral nodes are already well developed on the outer whorl of this specimen. The second specimen is a large one measuring 102 mm in diameter, 32.7 mm for the width of the adoral whorl, 39.5 mm for the height, and the umbilicus is 35.3 mm in diameter. The adoral half volution appears to be body chamber. This portion of the conch is still characterized by the prominent ventral tubercles and sinuous growth lines.

The sum total of the characters of this form set it apart from any of the Werfen Formation species of *Tirolites*. It likewise is totally different from *Tirolites astakhovi* which also occurs in the *Columbites* fauna of southeastern Idaho but at a different locality from where this species has been found.

Occurrence. The holotype (Pl. 54, figs. 2, 3) comes from the *Columbites* fauna, Thaynes Formation, Paris Canyon, southeast Idaho. The two plesiotypes recorded here (Pl. 54, figs. 1, 4, 5) come from the same horizons in Montpelier Canyon, southeast Idaho.

Repository. Holotype (Pl. 54, figs. 2, 3) USNM 74993; plesiotypes (Pl. 54, fig. 1) MCZ 9547, (Pl. 54, figs. 4, 5) MCZ 9548.

Tirolites astakhovi n. sp.

Plate 55, figures 1–3; Text-figure 40

Three excellently preserved specimens from the *Columbites* fauna of southeast Idaho are the basis for this new species. The measurements of the specimens are as follows.

	D	H	W	U
Holotype USNM 153081	51.5	14.3	?	26.0
Paratype Unfigured	82.4	22.2	?	42.2
Paratype USNM 153082	38.8	10.6	9.5	21.8

The conch is widely umbilicate with subrectangular whorl sections. The lateral areas are flattened, and the venter broadly arched. Both the ventral and umbilical shoulders are rounded. The lateral areas bear slightly prosiradiate ribs that begin on the umbilical shoulder and terminate at the ventral shoulder in a prominent node. On the smallest of the available specimens the nodes are much more prominent than on the other two specimens. Likewise on this small specimen the lateral areas are slightly divergent.

The suture of the holotype is illustrated on Figure 40G. The first lateral lobe lies just above the node on the ventral shoulder and the second lateral lobe lies on the umbilical shoulder and wall.

The morphological variations possible within species of the genus *Tirolites* were impressively illustrated by Kittl in his well-known monograph on the upper Werfen fauna from Muć. There is a strong temptation to assign these forms to one of the species described by Kittl. In fact, there is a marked morphological similarity with practically all of the thirteen species Kittl (1903: 52, 53) included in the Spinosi. The separation of this form from the Werfen species is done more as a matter of convenience than of conviction. More Idaho *Columbites* Zone material is needed, and the pattern of intraspecific variation in the Werfen species needs to be better understood before the relationships can be approached objectively.

Occurrence. From middle shale member of Thaynes Formation (*Columbites* fauna), on hillside north of Sage Creek, Stewart Flat Quadrangle, southeast Idaho.

Repository. Holotype, USNM 153081

(Pl. 55, figs. 1–2); figured paratype, USNM 153082 (Pl. 55, fig. 3); unfigured paratype USGS collections.

Tirolites cf. *cassianus* (Quenstedt)

Plate 34, figures 7–10; Text-figure 40

Tirolites cf. *spinosus* Mojsisovics,—Silberling, *in* Hose and Repenning, 1959: 2194.
Tirolites aff. *haueri* Mojsisovics,—Silberling, *in* Hose and Repenning, 1959: 2194.

The two specimens recorded here are clearly representatives of the Spinosi and could well be conspecific with the Werfen Formation species—*cassianus*. These specimens can be matched readily with several of the specimens illustrated by Kittl (1903). However, because the sample consists of only two fragmentary specimens it appears best to do no more than indicate a close affinity to the Werfen Formation species. The suture is shown on Figure 40E.

Occurrence. Thaynes Formation, Confusion Range, sample M111 in Hose and Repenning (1959, p. 2194).

Repository. USNM 153083 (Pl. 34, figs. 7, 8), USNM 153084 (Pl. 34, figs. 9, 10).

Tirolites sp. indet. II

Plate 55, figures 4, 5; Text-figure 40

A single specimen, consisting of approximately one half volution and much of the inner whorls, is clearly a tirolitid, but of uncertain specific affinities. The conch is evolute, with whorls that are about as wide as high on the earlier volutions but gradually become more compressed and higher than wide. The outer half volution of the specimen is half phragmocone and half body chamber. The lateral areas are flattened and the venter is broadly rounded. Both the ventral and umbilical shoulders are rounded. The umbilical wall slopes to the seam at an angle of approximately 45 degrees. The lateral areas bear widely spaced nodes which lie just dorsal of the ventral shoulders. There are approximately seven such nodes on the adoral half volution, and these show marked increase in size adorally. The shell bears sinuous growth lines that are slightly prosiradiate on the lateral areas and strongly projected forward in a broad arc over the venter.

The inner whorls, up to a diameter of 10 mm, are approximately as high as wide and the lateral areas bear radial ribs, some of which terminate in weak nodes at the ventral shoulder. On the next volution, that is, to a diameter of 20 mm, the whorls gradually increase in height, and the ornament consists only of widely spaced (four per half volution) conspicuous nodes at the umbilical shoulder.

The suture is shown on Figure 40F. The large first lateral lobe enclosed the ventrolateral node, and the second lateral lobe is on the umbilical wall. It is not difficult to find, among the numerous Werfen specimens illustrated by Kittl (1903), forms which are quite similar to the one mentioned here. However, because I am dealing with a single specimen, it seems best to merely document the occurrence of this form.

Occurrence. Middle shale member of Thaynes Formation (*Columbites* fauna), Montpelier Canyon, southeast Idaho.

Repository. MCZ 9502.

Genus *Diaplococeras* Hyatt

Type species, *Ceratites liccanus* Hauer, 1865

Diaplococeras liccanum (Hauer)

Ceratites liccanus Hauer, 1865: 616, pl. 3, figs. 1–3.
Dinarites liccanus,—Mojsisovics, 1882: 10, pl. 4, fig. 1; Tommasi, 1895: 69, pl. 4, fig. 14.
Diaplococeras liccanum,—Hyatt, 1900: 556; Spath, 1934: 379, fig. 128; Kummel, *in* Arkell et al., 1957: L147, fig. 180, 6.
Dinarites (*Liccaites*) *liccanus*,—Kittl, 1903: 26; Diener, 1915: 123.

Hauer (1865) based his species on one specimen. Mojsisovics apparently had three specimens for study; however, none of these specimens were available for study to the writer.

Occurrence. Werfen Formation, Muć, Dalmatia.

Diaplococeras connectens (Mojsisovics)
Plate 62, figures 1–4

Dinarites (*Ceratites*) *connectens* Mojsisovics, 1882: 9, pl. 3, fig. 10.
Dinarites (*Liccaites*) *connectens*,—Kittl, 1903: 25; Diener, 1915: 123.
Diaplococeras connectens,—Spath, 1934: 380.
Dinarites circumplicatus Mojsisovics, 1882: 8, pl. 3, figs. 8, 9.
Dinarites (*Liccaites*) *circumplicatus*,—Kittl, 1903: 24; Diener, 1915: 123.
Diaplococeras circumplicatus,—Spath, 1934: 380.
Dinarites biangulatus Kittl, 1903: 16, pl. 4, fig. 1; Diener, 1915: 120.
Dinarites (*Hercegovites*) *diocletiani* Kittl, 1903: 23, pl. 3, fig. 4; Diener, 1915: 122; Spath, 1934: 388.
Dinarites (*Liccaites*) *progressus* Kittl, 1903: 26, pl. 4, fig. 2; Diener, 1915: 123; Spath, 1934: 123.
Dinarites progressus,—Ganev, 1966: 27, pl. 2, fig. 2.

Poor preservation and misleading illustrations account for at least some of the confusion that has surrounded the species brought together here. The Werfen Formation contains a compressed form of ammonite that is modestly involute with low arched venter and conspicuous umbilical shoulder and umbilical wall. The suture is ceratitic with two lateral lobes. The flanks bear slightly prosiradiate ribs. Five species have been established for ammonites of the above general design. The major difference between these "species" is in their state of preservation. The specimens of the two species described by Mojsisovics—*connectens* and *circumplicatus*—were not personally studied. The three species established by Kittl (1903) were studied in detail.

The holotype of *Dinarites diocletiani* is shown here on Plate 62, figure 1. The specimen is crushed and the opposite side from that shown in the photograph has been destroyed by weathering. There are low, narrow, prosiradiate ribs on the flanks that are most conspicuous at and near the umbilical shoulder and decrease toward the ventral shoulder. The ribs also decrease in intensity adorally.

The holotype of *Dinarites biangulatus* is shown here on Plate 62, figures 3, 4. This specimen is highly weathered and only the body chamber approximates the original size and shape; the phragmocone is completely distorted by weathering. The basic outline of the whorls, degree of involution, and pattern of the suture (taking into account the weathering) is like that of *D. diocletiani*. The weathered body chamber has faint indications of ribs.

The holotype of *Dinarites progressus* Kittl, is shown here on Plate 62, figure 2. As can be seen, it also is a highly weathered specimen in which all surface features are obliterated or altered. In shape of whorl section, degree of involution and suture, it appears surely to be conspecific with the other forms included in this species.

The forms brought together here as *D. connectens* differ from *D. liccanum* in lacking peripheral clavi and umbilical tubercles.

Occurrence. Werfen Formation, Muć, Dalmatia, and eastern Bulgaria.

Repository. The specimens described by Kittl are in the Natural History Museum, Vienna. The specimen described by Ganev (1966) is in the Geological Institute of the Bulgarian Academy of Science; a plaster cast is in the Museum of Comparative Zoology.

Genus *Bittnerites* Kittl

Type species, *Tirolites (Bittnerites) bittneri* Kittl, 1903

Bittnerites bittneri (Kittl)
Plate 57, figures 1–6

Tirolites (*Bittnerites*) *bittneri* Kittl, 1903: 67, pl. 11, fig. 10; Diener, 1915: 280.
Bittnerites bittneri,—Spath, 1934: 381, fig. 130: Kummel, *in* Arkell, et al., 1957: L147, fig. 180, 3.
Tirolites (*Bittnerites*) *malici* Kittl, 1903: 67, pl. 3, fig. 8; Diener, 1915: 280.
Bittnerites malici,—Spath, 1934: 381, fig. 130.
Tirolites (*Bittnerites?*) *telleri* Kittl, 1903: 68, pl. 10, fig. 10; Diener, 1915: 280.

Of the three species Kittl (1903) assigned to his new genus *Bittnerites*, only

the illustrated specimen of each species is still preserved. The genotype specimen—*B. bittneri*—is weathered, measuring 50.5 mm in diameter, 12.3 mm for the width of the adoral whorl, 17.7 mm for the height, and 23.1 mm for the diameter of the umbilicus. None of the inner whorls are preserved. Kittl (1903: pl. 11, fig. 10) shows the venter to be sharpened; this, however, is entirely due to weathering. The normal condition of the venter is rounded. The large specimen which represents the type of *Bittnerites malici* is of slightly better preservation in that at least the inner whorls are preserved. This specimen measures 71.1 mm in diameter, 17.2 mm for the width of the adoral whorl, 23.1 mm for the height, and the umbilicus is 30.6 mm in diameter. Kittl (1903: pl. 2, fig. 8) shows prominent prosiradiate shallow constrictions at least on the body chamber of the specimen. A photograph of the specimen reproduced here on Plate 57, figure 3, shows no such furrows. It should again be emphasized that preservation of the Werfen Formation ammonites leaves much to be desired and fine surface details are seldom preserved.

The type specimen of *Bittnerites telleri* is a very poorly preserved specimen consisting only of the outer volution. It measures 59.0 mm in diameter, 17.3 mm for the width of the adoral whorl, 18.7 mm for the height, and the umbilicus is 25.4 mm in diameter. The prosiradiate shallow furrows are visible on part of the outer volution. This specimen differs from the type specimen of *B. malici* only in having slightly more inflated whorls; there is no justification for keeping these specimens in separate species.

The genus *Bittnerites* is known only from its type species.

Occurrence. Werfen Formation, Muć, Dalmatia.

Repository. Natural History Museum, Vienna.

Genus *Doricranites* Hyatt, 1889

Type species, *Ammonites bogdoanus* v. Buch, 1831

Doricranites bogdoanus (v. Buch)

Text-figure 40

Ammonites bogdoanus v. Buch, 1831: pl. 2, fig. 1; v. Buch, 1848: 16, pl. 5, figs. 6, 7.

Goniatites bogdoanus,—de Verneuil, *in* Murchison, Verneuil and Keyserling, 1845: 366, pl. 26, fig. 1.

Ceratites bogdoanus,—Auerbach, 1871: 49, pl. 4, figs. 1–8.

Balatonites bogdoanus,—Mojsisovics, 1882: 87, pl. 80, figs. 1–4.

Dorikranites bogdoanus,—Hyatt, *in* Whiteaves, 1889: 145; Spath, 1934, p. 382, fig. 131; Kummel, *in* Arkell et al., 1957: L147, fig. 180, 2.

Doricranites bogdoanus,—Diener, 1915: 129; Kiparisova, 1947: 169, pl. 43, fig. 1; Astakhova, 1960a: 155; Astakhova, 1960b: 149; Shevyrev and Shlezinger, 1960: 1418; Astakhova, 1962: 70, 75.

Balatonites rossicus Mojsisovics, 1882: 89, pl. 80, fig. 5.

Dorikranites rossicus,—Hyatt, *in* Whiteaves, 1889: 145.

Doricranites rossicus,—Diener, 1915: 129; Kiparisova, 1947: 170, pl. 43, fig. 4; Astakhova, 1960a: 154, 157; Astakhova, 1960b: 149; Shevyrev and Shlezinger, 1960: 1418; Astakhova, 1962: 75.

Doricranites tumulosus Astakhova, 1960a: 154, pl. 35, fig. 2, text-figs. 18, 19; Astakhova, 1960b: 149; Astakhova, 1962: 75.

Doricranites lanceolatus Astakhova, 1960a: 155, pl. 36, fig. 1, text-figs. 20, 21; Astakhova, 1960b: 149.

Doricranites schairicus Astakhova, 1960a: 156, pl. 36, fig. 2, text-figs. 22, 23; Astakhova, 1960b: 149; Astakhova, 1962: 75.

Doricranites ovatus Astakhova, 1960b: 149.

Doricranites discus Astakhova, 1960b: 149.

Doricranites rarecostatus Astakhova, 1960b: 149.

The criteria used to differentiate these several species of *Doricranites* are mainly ornamentation and shape of the whorl section. Examination of the few illustrations of these species suggests that the degree of ornamentation and compression of the conch are highly variable features. One gets the impression from Astakhova's discussion of the stratigraphy of the Scythian formations of the Mangyshlak Peninsula that *Doricranites* is a common fossil and

that most if not all of the species listed above occur together. On the basis of experiences with other ornamented Scythian ammonoids in which large numbers of specimens are available, it appears much more plausible that the species listed in the synonymy are part of a single species complex characteristic of a particular horizon in southern U.S.S.R. The only other species assigned to this genus is *D. acutus* which is considerably more involute. The suture of *D. bogdoanus* is illustrated on Figure 40O.

Occurrence. Scythian strata, Mount Bogdo, Mangyshlak Peninsula, and region of Tuarkyr in Turkmenia, southern U.S.S.R.

Doricranites acutus (Mojsisovics)

Balatonites acutus Mojsisovics, 1882: 89, pl. 80, fig. 6.

Dorikranites acutus,—Hyatt, *in* Whiteaves, 1889: 145.

Doricranites acutus,—Diener, 1915: 129; Astakhova, 1960a: 159; Schevyrev and Shlezinger, 1960: 1418.

Subdoricranites discoides Astakhova, 1960a: 158, pl. 35, figs. 3, 4, text-fig. 24 (*nomen nudum* of Bajarunas, 1936).

Subdoricranites orbiculatus Astakhova, 1964: 380, pl. 1, fig. 2.

This species differs from *bogdoanus* in being more compressed, more involute, and generally with a more subdued pattern of ornamentation.

Occurrence. This species along with *D. bogdoanus* is apparently quite common in the *Doricranites* Zone of Astakhova (1960a, b, 1962) at Mount Bogdo, Mangyshlak Peninsula, and the region of Tuarkyr in Turkmenia.

Family DINARITIDAE Mojsisovics, 1882

Genus *Dinarites* Mojsisovics, 1882

Type species, *Ceratites dalmatinus* Hauer, 1865

I recognize here four species of *Dinarites*, all confined to the western region of Tethys. The genus is an important member of the Werfen fauna where it is represented by two species. One of these (*carniolicus*) is the type species of *Carniolites*; this genus is considered to be a synonym of *Dinarites*. The presence of *Dinarites dalmatinus* in the *Subcolumbites* fauna of Chios is an important link in dating the Werfen fauna. The other two species of *Dinarites* (*liatsikasi* and *undatus*) are quite distinct from *dalmatinus* and *carniolicus* but closely related to each other. *Dinarites liatsikasi* is from the *Subcolumbites* fauna of Chios and *D. undatus* from the upper Scythian formations of the Mangyshlak Peninsula.

Dinarites dalmatinus (Hauer)

Plate 58, figures 1–10; Plate 59, figures 1–11; Plate 60, figures 1–8; Text-figure 40

Ceratites dalmatinus Hauer, 1865: 615, pl. 2, figs. 3, 4.

Dinarites dalmatinus,—Mojsisovics, 1882: 8, pl. 1, figs. 7, 8; Kittl, 1903: 18, pl. 2, figs. 1–11, pl. 3, figs. 1, 2; Hyatt and Smith, 1905: 162; Arthaber, *in* Frech, 1906: pl. 34, fig. 17; Diener, 1915: 120; Kummel, *in* Arkell, et al., 1957: L148, fig. 181, 1; Ganev, 1961: 182, pl. 2, figs. 4, 5, 8, pl. 4, fig. 6, pl. 6, fig. 2.

Dinarites dalmatinus var. *extensus* Kittl, 1903: 20, pl. 2, figs. 8, 9.

Dinarites dalmatinus var. *plurimcostatus* Kittl, 1903: 20, pl. 2, figs. 10, 11.

Dinarites dalmatinus var. *externeplanatus* Kittl, 1903: 20, pl. 2, figs. 1, 2.

Plococeras dalmatinum,—Hyatt, 1900: 556; Spath, 1934: 388, fig. 134.

Dinarites nudus Mojsisovics, 1882: 6, pl. 1, figs. 5, 6; Kittl, 1903: 17, pl. 1, figs. 11–13; Diener, 1915: 122; Renz and Renz, 1948: 48, pl. 1, figs. 1, 2.

Dinarites laevis Tommasi, 1902: 347, pl. 13, figs. 4, 5; Kittl, 1903: 13, pl. 1, figs. 1–3, pl. 3, figs. 10, 11; Diener, 1915: 121; Spath, 1934: 386.

Ceratites muchianus Hauer, 1865: 613, pl. 2, figs. 5, 6.

Dinarites muchianus,—Mojsisovics, 1882: 6, pl. 1, fig. 4; Kittl, 1903: 15, pl. 1, figs. 4–8; Arthaber, *in* Frech, 1906: pl. 34, fig. 16; Wittenburg, 1908: 285, pl. 40, fig. 20; Diener, 1915: 121; Spath, 1934: 386, fig. 132; Ganev, 1966: 26, pl. 1, figs. 3a–e.

Dinarites evolutior Kittl, 1903: 16, pl. 1, figs. 9, 10; Diener, 1915: 121; Spath, 1934: 384; Renz and Renz, 1948: 49, pl. 1, fig. 4; Kollárová-Andrusovová, 1961: 29, pl. 3, fig. 2.

Dinarites (?) *angulatus* Kittl, 1903: 22, pl. 3, fig. 9.

Dinarites multicostatus Kittl, 1903: 21, pl. 3, fig. 3; Diener, 1915: 122.
Dinarites tirolitoides Kittl, 1903: 21, pl. 7, figs. 1–3; Diener, 1915: 122.
Dinarites bulgaricus Berndt, 1934: 8, pl. 2, fig. 8.

Aside from *Tirolites* the most common element in the Werfen Formation fauna of the Alps and associated regions is *Dinarites*. A number of species names have been introduced for the dinaritids of this region but basically there are two main species, the first, encompassing predominantly smooth forms (*muchianus*), and the second, ornamented forms with ribs (*dalmatinus*). This second species had been set aside early (Hyatt, 1900) as the type of *Plococeras*. The latter genus had been accepted by Diener (1915) and Spath (1934). However, the selection of *dalmatinus* as the type of *Dinarites* Mojsisovics (1882), by Hyatt and Smith (1905, p. 162), makes *Plococeras* a synonym of *Dinarites*. Whereas the earlier authors wished to separate the smooth and ornamented dinaritids into distinct genera, my own studies bring me to the conclusion that we are dealing here with a single species complex rather than several species in two different genera.

The largest single collection of Werfen Formation dinaritids is that studied by Kittl (1903) and on deposit in the Natural History Museum, Vienna. The measurements of 38 specimens are listed on Table 46 and plotted on Figure 42. These 38 specimens represent the most complete and best preserved specimens available to Kittl, who illustrated most of them. Practically all of the remaining specimens that Kittl assigned to this or that species of dinaritid are very poorly preserved and of somewhat doubtful value. Kittl's illustrations are line drawings of better than average quality but yet lacking in not conveying the nature of preservation, imperfections in the conch, and at times with errors in artistry. All of the earlier illustrations for the Werfen Formation dinaritids are line drawings (e.g. Mojsisovics, 1882), and most of the more modern illustrations are impossible to decipher due to faulty printing and poor paper. Plates 58, 59, and 60 have photographic prints of the principal dinaritids studied by Kittl (1903). The smoothness of some of the specimens is clearly due to weathering and preservation. The number and intensity of the ribs is highly variable. Finally, there is a fair degree of variation in the diameter of the umbilicus (Fig. 42). Study of all of Kittl's specimens assigned to these species of dinaritids (smooth-*muchianus*; ribbed-*dalmatinus*) leads me to believe there is complete gradation from smooth to strongly ribbed forms. This observation plus the fact that all combinations of the morphological grades are found in nearly every fossiliferous locality in the Werfen Formation brings me to the conclusion we are dealing with a single, variable species.

The suture is illustrated on Figure 40H–J.

The dinaritids are a very small element in the *Subcolumbites* fauna of Chios. Renz and Renz (1948) record two specimens of *Dinarites nudus* Mojsisovics and two specimens of *Dinarites evolutior* Kittl. These specimens fall well within the range of variability recognized for *Dinarites dalmatinus* and are thus considered synonyms. The two specimens assigned to *Dinarites liatsikasi* (Renz and Renz, 1948: 49, pl. 1, fig. 3) are of special interest for the close similarity they show to *Dinarites undatus* Astakhova (1960a) from the Mangyshlak Peninsula. Each of these species is distinct from *D. dalmatinus* in ornamentation and in suture.

Occurrence. Primarily in Werfen Formation of the Alps and related regions. A few specimens are known from the *Subcolumbites* fauna of Chios.

Repository. The Werfen Formation specimens are in the Natural History Museum, Vienna; those from the *Subcolumbites* fauna of Chios are in the Natural History Museum, Basel, NHMB J13683–6; the specimens from eastern Bulgaria recorded by Ganev (1961, 1966) are in the Geological Institute of the Bulgarian Academy of

TABLE 46. MEASUREMENTS OF *DINARITES DALMATINUS* (HAUER) FROM WERFEN FORMATION, MUĆ, DALMATIA. ALL SPECIMENS ARE IN NATURAL HISTORY MUSEUM, VIENNA; DATA PLOTTED ON GRAPH OF FIGURE 42.

	D	W	H	U	W/D	H/D	U/D		D	W	H	U	W/D	H/D	U/D
1.	63.7?	16.7	29.5	16.4	26.2	46.3	25.7	20.	45.4	14.4?	18.8	11.7	31.8	41.5	25.8
2.	59.7	?	27.1	14.4	?	45.5	24.1	21.	45.0	14.0	18.7	13.1	31.1	41.5	29.1
3.	58.7	16.8	26.0	16.4	28.6	44.3	27.9	22.	44.5	10.1	17.3	15.3	22.7	38.9	34.4
4.	56.4	?	23.9	15.7	?	42.4	27.8	23.	44.3	?	20.4	10.1	?	46.0	22.8
5.	56.2	?	25.3	13.0	?	45.0	23.1	24.	44.2	?	20.5	10.8	?	46.4	24.4
6.	55.6	16.6?	22.6	17.5	29.9	40.6	31.5	25.	44.0	8.5	20.7	8.4	19.3	47.0	19.1
7.	54.8?	?	24.8	14.7	?	45.1	26.8	26.	43.5	11.8?	17.4	11.0	27.1	40.0	25.3
8.	53.8	12.3	22.5	13.7	22.9	41.8	25.5	27.	42.8	13.3	16.8	12.8	31.1	39.3	29.9
9.	53.0	12.7	22.7	?	24.0	42.8	?	28.	41.8	?	20.1	6.4	?	48.1	15.3
10.	52.8	14.5	24.4	11.3	27.5	46.2	21.4	29.	41.7	13.0	17.2	11.9	31.2	41.2	28.4
11.	51.4	16.6	19.8	17.7	32.4	38.6	34.5	30.	41.4	9.5?	17.8	11.3	23.0	43.0	27.3
12.	51.4	11.8	23.0	11.2	22.9	44.7	21.8	31.	41.3	13.2	17.7	11.7	32.0	42.9	28.4
13.	50.6?	10.4?	20.8	9.1	20.6	41.1	18.0	32.	41.1	11.2	18.3	9.5	27.3	44.5	23.1
14.	49.0	14.1	21.1	15.0?	28.8	43.1	30.6	33.	39.5	12.3?	16.5	10.8	31.1	41.8	27.3
15.	47.8	?	21.2	12.8	?	44.4	26.8	34.	39.4	12.3	16.0	11.5	31.2	40.6	29.2
16.	47.4	?	24.6?	5.9?	?	52.0	32.3	35.	38.9	9.0	19.4	6.7	23.1	49.9	17.2
17.	47.0?	13.0	23.7	10.2	27.6	50.5	21.7	36.	37.5	6.8	16.3	10.0	18.1	43.5	26.6
18.	46.6	?	20.5	10.2	?	44.0	21.9	37.	34.7	?	15.5	9.2	?	44.7	26.5
19.	45.5	11.4	19.2	10.9	25.1	42.2	24.0	38.	26.2	6.3	13.5	3.8	24.4	51.5	14.5

1. Plesiotype,—Kittl (1903: pl. 2, fig. 5).
2. Plesiotype,—Kittl (1903: pl. 2, fig. 6).
3. Plesiotype,—Kittl (1903, pl. 2, fig. 4).
4. Plesiotype,—Kittl (1903, pl. 2, fig. 7).
5. Unfigured paratype, *Dinarites evolutior* Kittl.
6. Unfigured paratype, *Dinarites multicostatus* Kittl.
7. Plesiotype,—Kittl (1903: pl. 2, fig. 1).
8. Unfigured paratype, *Dinarites evolutior* Kittl.
9. Syntype, *Dinarites evolutior* Kittl (1903: pl. 1, fig. 10).
10. Plesiotype, *Dinarites muchianus*,—Kittl (1903: pl. 1, fig. 6).
11. Figured type, *Dinarites tirolitoides* Kittl (1903: pl. 7, fig. 2).
12. Plesiotype, *Dinarites muchianus*,—Kittl (1903: pl. 1, fig. 8).
13. Syntype, *Dinarites evolutior* Kittl (1903: pl. 1, fig. 9).
14. Unfigured paratype, *Dinarites tirolitoides* Kittl.
15. Unfigured paratype, *Dinarites evolutior* Kittl.
16. Plesiotype, *Dinarites laevis*,—Kittl (1903: pl. 1, fig. 1).
17. Plesiotype,—Kittl (1903: pl. 2, fig. 8).
18. Plesiotype, *Dinarites muchianus*,—Kittl (1903: pl. 1, fig. 7).
19. Plesiotype, *Dinarites nudus*,—Kittl (1903: pl. 1, fig. 13).
20. Figured type, *Dinarites tirolitoides* Kittl (1903: pl. 7, fig. 3).
21. Plesiotype,—Kittl (1903: pl. 2, fig. 9).
22. Figured type, *Dinarites multicostatus* Kittl (1903: pl. 3, fig. 3).
23. Unfigured paratype, *Dinarites evolutior* Kittl.
24. Plesiotype,—Kittl (1903: pl. 2, fig. 11).
25. Plesiotype, *Dinarites laevis*,—Kittl (1903: pl. 3, fig. 11).
26. Plesiotype,—Kittl (1903: pl. 2, fig. 2).
27. Unfigured paratype, *Dinarites tirolitoides* Kittl.
28. Plesiotype, *Dinarites laevis*,—Kittl (1903: pl. 1, fig. 2).
29. Plesiotype,—Kittl (1903: pl. 3, fig. 1).
30. Plesiotype,—Kittl (1903: pl. 2, fig. 10).
31. Plesiotype,—Kittl (1903: pl. 3, fig. 2).
32. Plesiotype, *Dinarites muchianus*,—Kittl (1903: pl. 1, fig. 5).
33. Plesiotype, *Dinarites nudus*,—Kittl (1903: pl. 1, fig. 11).
34. Figured type, *Dinarites tirolitoides* Kittl (1903: pl. 7, fig. 1).
35. Plesiotype, *Dinarites laevis*,—Kittl (1903: pl. 1, fig. 3).
36. Plesiotype, *Dinarites laevis*,—Kittl (1903: pl. 3, fig. 10).
37. Unfigured paratype, *Dinarites evolutior* Kittl.
38. Plesiotype, *Dinarites muchianus*,—Kittl (1903: pl. 1, fig. 4).

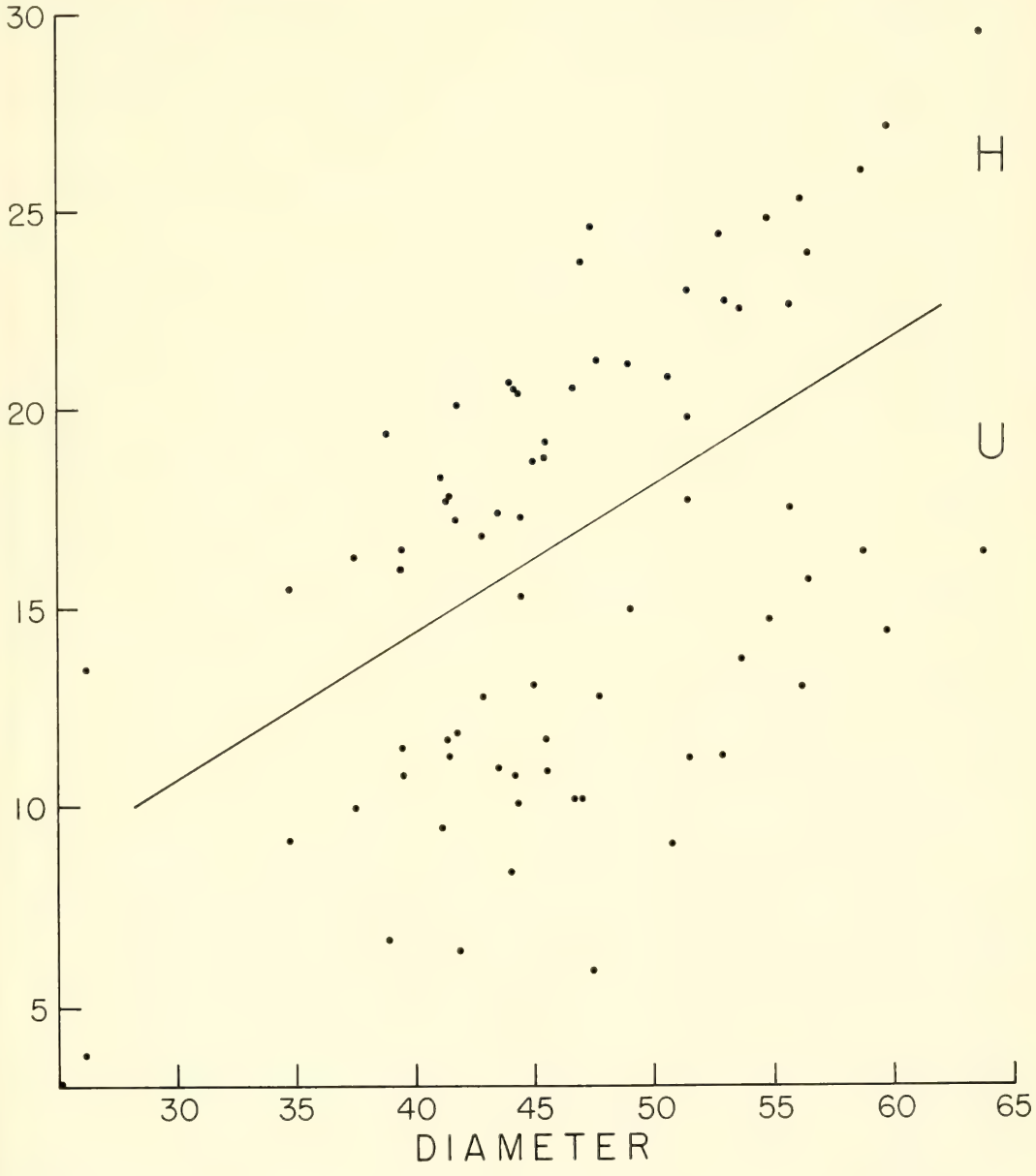

Figure 42. Variation in whorl height (H) and umbilical diameter (U) of *Dinarites dalmatinus* (Hauer), from Werfen Formation, Muć, Dalmatia. The data on this graph are from Table 46.

TABLE 47. MEASUREMENTS OF SPECIMENS OF *DINARITES CARNIOLICUS* (MOJSISOVICS) FROM THE WERFEN FORMATION, DALMATIA, FIGURED BY KITTL (1903). ALL SPECIMENS ARE IN THE NATURAL HISTORY MUSEUM, VIENNA.

	D	W	H	U	W/D	H/D	U/D
1.	59.3	11.7	26.8	11.2	19.7	45.2	19.2
2.	58.5	?	24.6	15.5	?	42.1	26.5
3.	57.2	?	23.0	16.2	?	40.0	28.3
4.	55.2	10.0±	23.2	10.4	18.1±	42.0	18.8
5.	53.3	12.0?	24.2	12.2	22.5?	45.4	22.9
6.	52.7	10.5?	26.2	10.1	19.9	49.7	19.2
7.	52.6	12.0?	23.7?	10.3?	22.8	45.1?	19.6?

1. Plesiotype,—Kittl (1903: pl. 5, fig. 1).
2. Plesiotype,—Kittl (1903: pl. 5, fig. 2).
3. Holotype, *Tirolites heterophanus* Kittl (1903: pl. 5, fig. 7).
4. Syntype, *Tirolites serratelobatus* Kittl (1903: pl. 5, fig. 6).
5. Plesiotype,—Kittl (1903: pl. 5, fig. 3).
6. Syntype, *Tirolites serratelobatus* Kittl (1903: pl. 5, fig. 5).
7. Plesiotype,—Kittl (1903: pl. 5, fig. 4).

Science; plaster casts are in the Museum of Comparative Zoology.

Dinarites carniolicus (Mojsisovics)

Plate 61, figures 1–8

Tirolites carniolicus Mojsisovics, 1882: 65, pl. 1, figs. 2, 3; Kittl, 1903: 35, pl. 5, figs. 1–4; Diener, 1915: 277.

Carniolites carniolicus,—Arthaber, 1911: 241, 250; Spath, 1934: 392, fig. 136; Kummel, *in* Arkell, et al., 1957: L148, fig. 181,3; Kollárová–Andrusovová, 1962: 31, pl. 2, figs. 6a–c, pl. 3, fig. 4.

Tirolites serratelobatus Kittl, 1903: 36, pl. 5, figs. 5, 6; Arthaber, 1911: 250; Diener, 1915: 279.

Tirolites heterophanus Kittl, 1903: 38, pl. 5, fig. 7; Arthaber, 1911: 250.

This species differs from the "smooth" class of dinaritids merely in the presence of fairly prominent tubercles near the ventral shoulder on the adoral part of the phragmocone and body chamber. I can see no justification for a separation at the generic level. Kittl's types of the species brought together here as *D. carniolicus* are illustrated here on Plate 61. The measurements of these specimens are shown on Table 47.

Occurrence. The specimens studied here are from the Werfen Formation, Muć, Dalmatia. The species is also recorded from the same formation in Czechoslovakia (Kollárová–Andrusovová, 1961, 1962).

Repository. The specimens from Muć, studied here, are in the Natural History Museum, Vienna.

Dinarites liatsikasi Renz and Renz

Text-figure 40

Dinarites liatsikasi Renz and Renz, 1947: 60, 75; Renz and Renz, 1948: 49, pl. 1, fig. 3.

Ornamentation and suture (Fig. 40N) differentiate this species from *Dinarites dalmatinus*. The ribbing consists of slightly prosiradiate folds that cross a subtruncate venter. The suture is goniatitic but with a very broad first lateral lobe. The holotype measures 35.7 mm in diameter, 11.2 mm for the width of the adoral whorl, 16.2 mm for the height, and 9.8 mm for the diameter of the umbilicus. This species is very similar to *Dinarites undatus* Astakhova from the Mangyshlak Peninsula. In that species the radial ribs are slightly sinuous and are somewhat enlarged at the umbilical shoulder. The suture, likewise, has a much narrower first lateral lobe. There is a superficial similarity in conch form to *Cucoceras* as indicated by Renz and Renz (1948) but the suture is completely different.

Occurrence. Subcolumbites fauna, Chios.

Repository. Holotype NHMB J13687, paratypes NHMB J13688.

Dinarites undatus Astakhova

Text-figure 40

Dinarites undatus Astakhova, 1960a: 152, pl. 34, fig. 9, text-fig. 17.

A species of the general design and form of *D. liatsikasi* from the *Subcolumbites* fauna of Chios. The general features are discussed under the discussion of that species. The suture is illustrated on Figure 40M.

Occurrence. Tirolites Zone of Astakhova (1960a), Mangyshlak Peninsula.

Genus *Hololobus* (Kittl)

Type species, *Tirolites (Hololobus) monoptychus* Kittl, 1903

***Hololobus monoptychus* (Kittl)**
Plate 70, figures 1, 2; Text-figure 40

Tirolites (Hololobus) monoptychus Kittl, 1903: 33, pl. 4, fig. 9; Diener, 1915: 280.
Hololobus monoptychus,—Spath, 1934: 390, fig. 135; Kummel, *in* Arkell, et al., 1957: L148, fig. 181,5.

The type, and only specimen, of this species and genus is of only fair preservation. It measures 61.8 mm in diameter, 15.7 mm for the width of the adoral whorl, 26.7 mm for the height, and the umbilicus is 16.8 mm in diameter. The critical point of interest with this species is the nature of the ventral lobe. Examination of the type specimen clearly shows that Kittl's drawing of the suture (Fig. 40K) is accurate. Like Kittl, I could not observe any trace of a ventral siphuncle, but this I attribute more to faulty preservation than to anything else.

Occurrence. Werfen Formation, Muć, Dalmatia.

Repository. Natural History Museum, Vienna.

Genus *Pseudodinarites* Hyatt

Type species, *Dinarites mohamedanus* Mojsisovics, 1882

***Pseudodinarites mohamedanus* (Mojsisovics)**
Plate 57, figures 7–9; Plate 62, figure 6

Dinarites mohamedanus Mojsisovics, 1882: 7, pl. 40, fig. 12.
Pseudodinarites mohamedanus,—Hyatt, 1900: 559; Spath, 1934: 387, fig. 133; Kummel, *in* Arkell et al., 1957: L148.
Dinarites (Hercegovites) mohamedanus,—Kittl, 1903: 22, pl. 3, figs. 5–7; Diener, 1915: 122.

This species is supposedly characterized by an evolute, smooth conch with rounded but slightly compressed whorls and suture with ceratitic lobes. Mojsisovics' type specimen was not studied; the specimens assigned to this species by Kittl are illustrated here. These specimens are so poorly preserved they add little to our understanding of this genus or species. The few specimens of this species have all come from the Werfen Formation of the Alps and adjacent regions. Simionescu (1908: 161) recorded a specimen as *Dinarites* cfr. *mohamedanus* from eastern Rumania. This is the only species that has been assigned to this genus. It is quite clear much more data are needed to evaluate the generic relations of the species.

Occurrence. Kittl's specimens illustrated here are from the Werfen Formation, Muć, Dalmatia.

Repository. Kittl's specimens are in the Natural History Museum, Vienna.

Family HELLENITIDAE Kummel, 1952

Genus *Hellenites* Renz and Renz, 1947

Type species, *Tropiceltites praematurus* Arthaber, 1911

Evolute forms with subquadrate whorl section. Lateral sides with rectiradiate to radial ribs which curve adorally on ventral shoulder forming an acute junction with a median ventral keel; ribs may or may not cross keel. Suture with simple pronged ventral lobe, large, denticulated lateral lobe and very simple second lateral lobe, saddles rounded.

This extremely interesting and somewhat anomalous group of late Scythian ammonoids has been the source of an evolving confusion. The group was first recognized by Arthaber (1911) on the basis of two specimens from the *Subcolumbites* fauna of Albania. Neither of these two specimens had the suture preserved, and on the basis of the conch form and ornamentation, he placed them in the genus *Tropiceltites*, a common late Triassic (Carnian) group. A more complete understanding of Arthaber's species was not possible until Renz and Renz (1948) described and illustrated a number of conspecific forms from the *Subcolumbites* fauna of Chios. The suture is

well preserved on these Chios specimens and shows that it is very different from the suture of the late Triassic *Tropiceltites*. On this basis, Renz and Renz erected the genus *Hellenites*.

Neither of these authors, however, had taken note of *Pseudharpoceras spiniger* Waagen (1895: 130, pl. 21, fig. 1). This species was based on a single specimen from a horizon Waagen considered to be near the top of his Ceratite formation in the Sheik-Budin Hills of the Trans-Indus Region. Spath (1951: 8) correctly pointed out that the specimens may belong to an Upper Triassic hildoceratid or some other related form.

J. P. Smith (1932) assigned a single specimen from the *Columbites* fauna of southeastern Idaho to the genus *Pseudharpoceras*. Spath (1951: 9) made the claim, and correctly so, that since *Pseudharpoceras* was based on a poorly preserved specimen of uncertain stratigraphic position this genus should be rejected. He then introduced the genus *Pseudarniotites* with *Pseudharpoceras idahoense* Smith (1932: 81, pl. 49, figs. 17–19) as type. Spath was at this time unaware of the genus *Hellenites* Renz and Renz, 1948. *Pseudharpoceras idahoense* is clearly a species of *Hellenites*.

The specimen Waagen described and illustrated as *Pseudharpoceras spiniger* is not in the collections of the Geological Survey of India. There is, however, a partial mold of one side plus a plaster cast. These have been illustrated and discussed by Kummel (1966) and his conclusion was similar to that of Spath: that the genus and species should be rejected.

The *Subcolumbites* fauna of Chios has two species of this genus. One or both of these two species are recognized from the same horizon in Kwangsi, China, from the Primorye Region, eastern Siberia, and the Tobin Formation of Nevada. *Hellenites idahoense* occurs in the *Columbites* fauna of southeastern Idaho.

TABLE 48. MEASUREMENTS OF *HELLENITES PRAEMATURUS* (ARTHABER) FROM *SUBCOLUMBITES* FAUNAS, ALBANIA AND CHIOS.

	D	W	H	U	W/D	H/D	U/D
1.	55.2	13.2	17.7	25.5	23.9	32.1	46.2
2.	53.4	14.3	15.0	29.0	26.6	27.2	54.5
3.	52.3	15.9	16.8	26.2	30.4	32.2	50.1
4.	48.2	12.2	14.0	23.0	25.3	29.1	47.8
5.	47.0?	13.2	14.5?	22.4	28.1?	30.9?	47.6?
6.	46.2	11.7?	13.8	18.6	25.4?	29.9	41.0
7.	44.2	11.6?	14.4	20.5	27.2?	32.6	46.4
8.	43.3	13.0	13.2	21.1	30.0	30.6	48.7
9.	42.1	12.1?	12.8	20.2	28.7?	30.4	47.9?
10.	36.8	10.3	10.5	17.1	28.0	28.5	46.5
11.	36.7	10.7	10.7	17.4	29.2	29.2	47.4
12.	36.3	9.6?	11.9	16.6	26.4?	32.8	45.7
13.	36.2	9.2	10.1	19.2	25.4	27.9	53.0
14.	35.8	10.8	11.0	16.0	30.2	30.7	44.7
15.	34.1	10.7	10.4	14.6?	31.4	30.5	42.8
16.	33.4	10.1	11.1?	14.5	30.2	33.2?	43.4
17.	33.0	9.8	10.9	14.7	29.7	33.0	44.5
18.	25.7	8.0	6.8	13.0	31.1	26.5	50.6
19.	25.7	8.2?	9.1	10.2	31.9?	35.4	39.0
20.	25.5	7.5	7.5	10.8?	29.4	29.4	42.4?
21.	23.3	6.8	7.7	9.6	29.2	33.0	41.2
22.	19.1	7.8?	6.2	8.8	40.8?	32.4	46.0
23.	16.6	6.1	6.0	7.0	36.7	36.1	42.2
24.	13.8	6.3	4.8	5.6?	45.7	34.8	40.6?

1. Syntype, *H. praematurus* var. *aegaeica* Renz and Renz (1947: 60; 1948, pl. 2, fig. 6), NHMB J13664.
2. Holotype, *H. trikkalinoi* Renz and Renz (1947: 60, 75; 1948, pl. 2, fig. 2), NHMB J13668.
3, 9, 15, 18, 24. Unfigured paratypes, *H. trikkalinoi*, Maradovuno, Chios, NHMB J13672.
4, 23. Unfigured paratypes, Kephalovuno, Chios, NHMB J13673.
5. Syntype, *H. praematurus* var. *aegaeica* Renz and Renz (1947: 60; 1948, pl. 2, fig. 8), NHMB J13665.
6, 10, 14, 16, 17, 20, 21. Unfigured paratypes, Maradovuno, Chios, NHMB J13662.
7. Type specimen, *H. trikkalinoi* var. *graeca* Renz and Renz (1947: 60; 1948, pl. 2, fig. 5), NHMB J13674.
8. Plesiotype,—Renz and Renz (1948: pl. 2, fig. 7), NHMB J13660.
11. Plesiotype, –Renz and Renz (1948: pl. 2, fig. 3), NHMB J13661.
12. Syntype, *H. praematurus* var. *aegaeica* Renz and Renz (1947: 60; 1948, pl. 2, fig. 9), NHMB J13667.
13. Paratype, *H. trikkalinoi* Renz and Renz (1948: pl. 2, fig. 4), NHMB J13671.
19. Holotype, *H. praematurus* (Arthaber, 1911: pl. 24 (8), figs. 9a, b), PIUV.
22. Holotype, *H. praematurus* var. (Arthaber, 1911: pl. 24(8), figs. 10a, b), PIUV.

Hellenites praematurus (Arthaber)

Plate 7, figures 1–4; Text-figure 43

Tropiceltites praematurus Arthaber, 1911: 268, pl. 24(8), figs. 9a, b; C. Renz, 1928: 155.

Tropiceltites ? *praematurus* var. Arthaber, 1911: 269, pl. 24(8), figs. 10a, b.

Tropiceltites (?) *praematurus*.—Diener, 1915: 300.

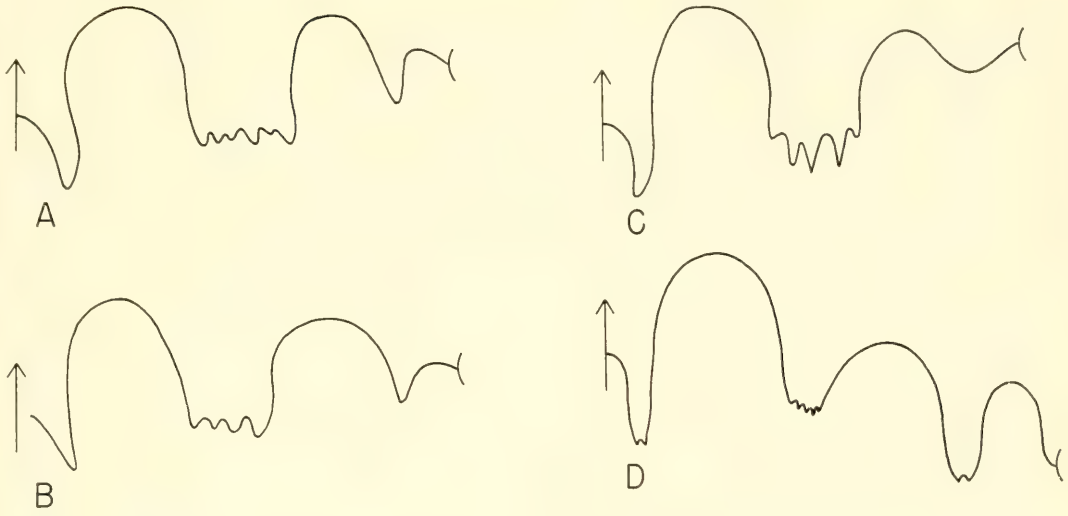

Figure 43. Diagrammatic representation of the suture of: A, *Hellenites trikkalinoi* Renz and Renz (1948: pl. 2, fig. 2b), at a diameter of 35 mm; B, *H. praematurus* (Arthaber),—Renz and Renz (1948: pl. 2, fig. 8b), at a diameter of 30 mm; C, *H. radiatus* Renz and Renz (1948: pl. 2, fig. 13b), at a diameter of 20 mm; D, *H. idahoense* (Smith) (USNM 74994), at a diameter of 13 mm.

Specimens of figures A–C from *Subcolumbites* fauna, Chios; specimen of figure D from *Columbites* fauna of southeast Idaho.

Hellenites praematurus,—Renz and Renz, 1947: 60, 75; Renz and Renz, 1948: 44, pl. 2, figs. 3–3a, 7–7a; Kummel, *in* Arkell et al., 1957: L149, figs. 181, 6a–c.

Hellenites praematurus var. *aegaeica* Renz and Renz, 1947: 60; Renz and Renz, 1948: 45, pl. 2, figs. 6–6b, 8–8b, 9–9a.

Hellenites trikkalinoi Renz and Renz, 1947: 60, 75; Renz and Renz, 1948: 46, pl. 2, figs. 1–1a, 2–2b, 4–4b.

Hellenites trikkalinoi var. *graeca* Renz and Renz, 1947: 60; Renz and Renz, 1948: 46, pl. 2, figs. 5–5b.

Hellenites cf. *praematurus*,—Chao, 1959: 145, pl. 41, figs. 1, 2 (not 3, 4).

This species was established by Arthaber on the basis of two specimens, one of which he considered to be a variety. The preservation of both of these specimens leaves much to be desired. The measurements are as follows:

D	W	H	U	W/D	H/D	U/D
25.7	8.2?	9.1	10.2	31.9?	35.4	39.7

Holotype—Arthaber, 1911: pl. 24(8), fig. 9a, b.

19.1	7.8?	6.2	8.8	40.8?	32.5	46.1

Paratype—Arthaber, 1911: pl. 24(8), fig. 10 a, b.

The suture is not preserved on either of these specimens.

This anomalous late Scythian species remained somewhat of a problem until the discovery of the contemporaneous *Subcolumbites* fauna from Chios. A number of specimens of *H. praematurus* have been well illustrated by Renz and Renz (1948). In addition to *H. praematurus,* these authors recognized a variety and another species based mainly on the relative prominence of the ribs. It is apparent on examination of the large number of specimens in the fauna studied by Renz and Renz that there is wide variation in rib prominence, and that there are gradational forms connecting the species and varieties recognized. In the other morphological features, as width, height and umbilical diameter, there is relatively little variation (see Table 48 and Figure 44). The sutures are illustrated on Figures 43 A, B.

Chao (1959) obtained two fragmentary

specimens from separate localities of the *Subcolumbites* horizon, which he described as *H.* cf. *praematurus*. One of these specimens (Chao, 1959: pl. 41, figs. 1, 2) is identical in rib pattern, conch shape, etc., to *H. praematurus*. Though a suture is not preserved on this specimen, I believe it to be a valid representative of *H. praematurus*. The second specimen is more fragmentary and of poorer preservation. The rib pattern, however, compares favorably with *H. radiatus*.

Occurrence. Subcolumbites faunas of Albania, Chios, and Kwangsi, China (Chao collections 542a, 546).

Repository. Holotype and paratype, in the Paleontological Institute, Vienna; specimens from Chios, plesiotypes, Renz and Renz (1948: pl. 2, figs. 3–3a) NHMB J13661, (1948: pl. 2, figs. 7–7a) NHMB J13660; unfigured specimens from Maradovuno NHMB J13662; unfigured specimens from Kephalovuno NHMB J13663; type specimens, *H. praematurus* var. *aegaeica* Renz and Renz (1948: pl. 2, fig. 6) NHMB J13664, (pl. 2, figs. 8–8a) NHMB J13665, (pl. 2, fig. 8b) NHMB J13666, (pl. 2, fig. 9) NHMB J13667; holotype *H. trikkalinoi* Renz and Renz (1948: pl. 2, fig. 2–2a) NHMB J13668; paratypes, Renz and Renz (1948: pl. 2, fig. 1) NHMB J13670, (pl. 2, fig. 4) NHMB J13671, (pl. 2, fig. 2b) NHMB J13669; unfigured paratypes from Maradovuno NHMB J13672, from Kephalovuno NHMB J13673; type specimen *H. trikkalinoi* var. *graeca* Renz and Renz (1948: pl. 2, fig. 5) NHMB J13674.

Hellenites radiatus Renz and Renz
Text-figure 43

Hellenites (Pallasites) radiatus Renz and Renz, 1947: 60, 75; Renz and Renz, 1948: 47, pl. 2, figs. 12–12b, 13–13b.

Hellenites (Pallasites) striatus Renz and Renz, 1947: 60, 75; Renz and Renz, 1948: 47, pl. 2, figs. 11–11a.

Hellenites (Pallasites) striatus var. *densicostata* Renz and Renz, 1947: 60, 75; Renz and Renz, 1948: 48, pl. 2, figs. 10–10b.

Hellenites cf. *praematurus* Chao, 1959: 145, pl. 41, figs. 3, 4 (not 1 and 2).

Table 49. Measurements of *Hellenites radiatus* Renz and Renz from the *Subcolumbites* fauna of Chios.

	D	W	H	U	W/D	H/D	U/D
1.	43.7	10.9	13.5	20.5	24.9	30.9	46.9
2.	37.1	10.5	12.7	15.7	28.3	34.2	42.3
3.	33.4?	8.5	11.7	8.2	25.4?	35.0?	24.6?
4.	31.2	8.5	10.1	14.1	27.2	32.4	45.2
5.	30.2	7.2	8.7	14.7	23.8	28.8	48.7
6.	29.5	8.5	9.8	12.6	28.8	33.2	42.7
7.	28.7	8.2	10.0	12.5	28.6	34.8	43.6
8.	27.8?	7.0	8.3	13.2	25.2?	29.9?	47.5?
9.	26.7	6.1	7.8	12.7	22.8	29.2	47.6
10.	22.8	5.4	7.4	10.3	23.7	32.5	45.2
11.	22.3	6.8	6.4	10.1	30.5	28.7	45.3
12.	17.8	5.1?	5.5	8.5	28.7?	30.9	47.8

1, 2. Unfigured paratypes, Maradovuno, Chios, NHMB J13678.
3. Holotype, *H.* (*Pallasites*) *striatus* var. *densicostata* Renz and Renz (1947: 60, 75; 1948: pl. 2, fig. 10), NHMB J13681.
4. Paratype, Renz and Renz (1947: 60, 75; 1948, pl. 2, fig. 13), NHMB J13677.
5, 6, 11, 12. Unfigured paratypes, *H.* (*Pallasites*) *striatus*, Maradovuno, Chios, NHMB J13680.
7. Holotype, Renz and Renz (1947: 60, 75; 1948: pl. 2, fig. 12), NHMB J13675.
8. Holotype, *H.* (*Pallasites*) *striatus* Renz and Renz (1947: 60, 75; 1948: pl. 2, fig. 11), NHMB J13679.
9, 10. Unfigured paratypes, *H.* (*Pallasites*) *striatus* var. *densicostata*, Maradovuno, Chios, NHMB J13682.

This species is exactly like *H. praematurus* except that the ribs are radial instead of rursiradiate. Renz and Renz (1948) distinguished within this group two species under a separate subgenus of *Hellenites*. The two species were separated on the basis of rib prominence, but again the collections have a number of transitional forms in this character. The suture (Fig. 43H) is essentially the same as in *H. praematurus*.

The only distinguishing feature between *H. praematurus* and *H. radiatus* is the character of the lateral ribs. This is presumably a valid species criterion but not one to warrant erection of a separate subgenus.

This species is not as abundant in the Chios fauna as *H. praematurus*. As in the latter species, *H. radiatus* does not exhibit any marked variability in the basic conch dimensions. On Table 49 are measurements of 12 specimens including the primary

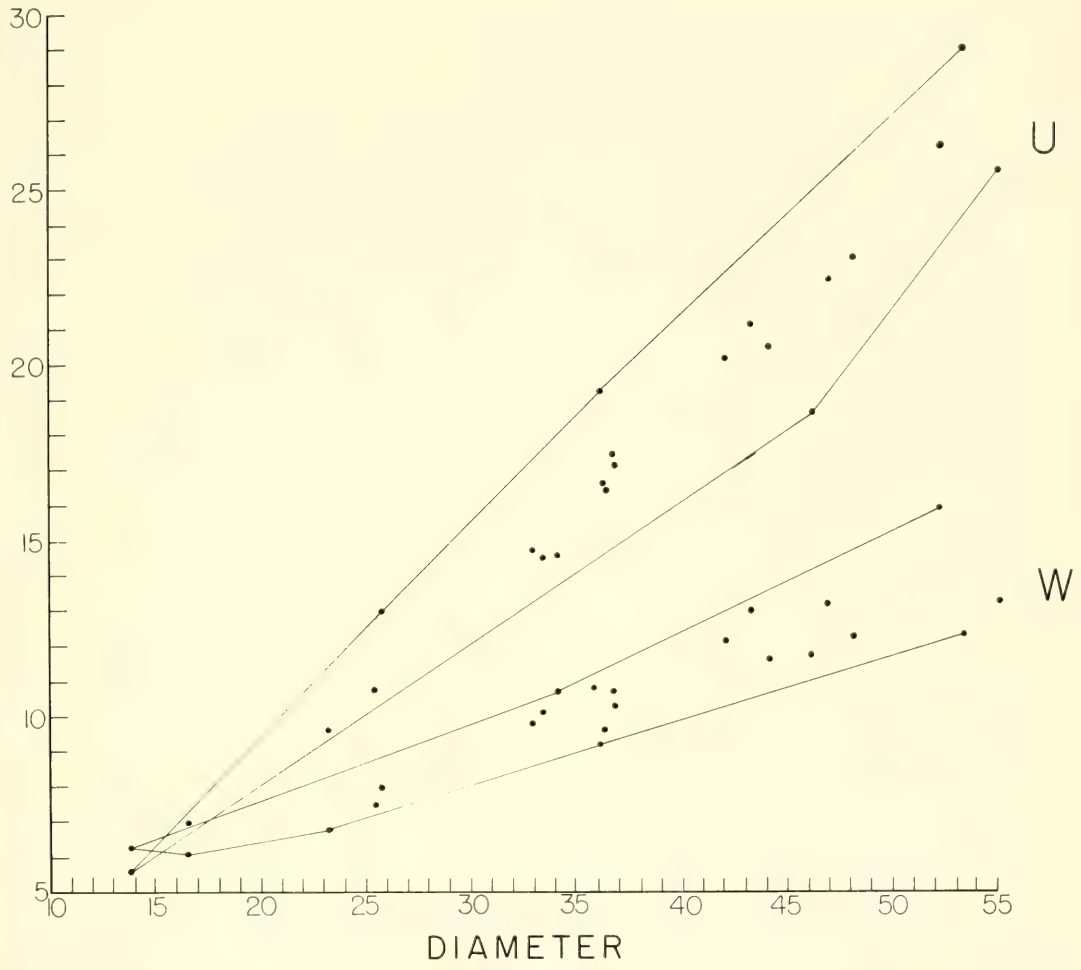

Figure 44. Variation in whorl width (W) and umbilical diameter (U) of *Hellenites praematurus* (Arthaber), from the *Subcolumbites* fauna of Albania and Chios. The data on this graph are from Table 48.

types. The measurements are plotted on Figure 44.

One of the specimens from a *Subcolumbites* horizon in Kwangsi, China, that Chao (1959: pl. 41, figs. 3, 4) assigned to *H.* cf. *praematurus* has radial ribs and should be assigned to *H. radiatus*. The specimen is poorly preserved and lacks a suture, but the pattern of ornamentation, etc., is so distinctive that this conclusion seems justified.

The Tobin Formation of Nevada has yielded one specimen, 18 mm in diameter, that appears to be identical to the other representatives of this species. No suture is preserved, but the degree of involution, ornamentation, etc., are identical.

The species of *Hellenites* from Chios and Kwangsi are from *Subcolumbites* faunas. There are two older species which need to be attached to this genus. These are *H. idahoense* (Smith, 1932: 81, pl. 49, figs. 13–19) from the *Columbites* fauna of southeastern Idaho, and *H. inopinatus* Kiparisova (1958a) from the Primorye Region at a horizon equivalent to the *Columbites* Zone of Idaho.

Occurrence. The holotype and paratype from the *Subcolumbites* fauna of Chios; from *Subcolumbites* fauna, Naliling, one kilometer northeast of Lolou, Lingolo district, Kwangsi, China; upper part of Tobin Formation, south end of Tobin Range, Nevada.

Repository. Holotype, Renz and Renz (1948: pl. 2, figs. 12–12a) NHMB J13675; paratypes, Renz and Renz (1948: pl. 2, fig. 12b) NHMB J13676, (pl. 2, figs. 13–13b) NHMB J13677; unfigured paratypes from Maradovuno NHMB J13678; holotype, *H. (Pallasites) striatus* Renz and Renz (1948: pl. 2, figs. 11–11a) NHMB J13679; unfigured paratypes NHMB J13680; type specimens *H. (Pallasites) striatus* var. *densicostata* Renz and Renz (1948: pl. 2, figs. 10–10b) NHMB J13681; unfigured paratypes NHMB J13682; specimen from Tobin Formation MCZ 9654.

Hellenites idahoense (Smith)

Plate 53, figures 13, 14; Text-figure 43

Pseudharpoceras idahoense Smith, 1932: 81, pl. 49, figs. 17–19.
Pseudarniotites idahoense,—Spath, 1951: 9.

Smith based his species on a small fragmentary specimen 19 mm in diameter, and extensive collecting from the same horizon in southeastern Idaho has not yielded any additional specimens. This species is very similar in its basic morphological features to *H. radiatus.* The differences are mainly seen in the character of the ribs on the venter, the character of the keel, and the suture (Fig. 43D).

Most other occurrences of *Hellenites* are from *Subcolumbites* faunas of latest Scythian age. This species is from the *Columbites* Zone.

Occurrence. Middle shale member, Thaynes Formation, *Columbites* Zone, Paris Canyon, southeastern Idaho.

Repository. Holotype, USNM 74994.

Hellenites inopinatus Kiparisova

Hellenites (?) *inopinatus* Kiparisova, 1958a: 13, fig. 9; Kiparisova, 1961: 169, pl. 33, fig. 4.

Kiparisova had six specimens upon which to base her species, but unfortunately none of these yielded a suture, nor was the preservation of the specimens particularly good. On the basis of the illustrations and figures of the holotype, this species is quite similar to *H. radiatus* Renz and Renz from the *Subcolumbites* fauna of Chios. Kiparisova (1961) did not give precise stratigraphic data on her species, but Zakharov (personal communication) tells me that the species is in his *Neocolumbites insignis* Subzone which is correlative with the *Columbites* fauna of southeast Idaho. Kiparisova's species is not very similar to *Hellenites idahoense* (Smith) from the *Columbites* fauna of southeast Idaho.

Occurrence. Neocolumbites insignis Subzone, Primorye Region.

Family BEYRICHITIDAE Spath, 1934

Genus *Beyrichites* Waagen, 1895

Type species, *Ammonites reuttensis* Beyrich, 1867

Beyrichites laurae Renz and Renz

Text-figure 45

Beyrichites laurae Renz and Renz, 1948: 62, pl. 8, fig. 1.
Beyrichites praematurus Renz and Renz, 1948: 61, pl. 7, fig. 5.

The authors of this species were fully cognizant that the presence of this typical Anisian genus in their Chios fauna raised serious questions. They briefly discussed the possibility of mixing and reworking versus the true existence of this genus in the late Scythian. On the basis of the data available, I have elected to accept this species as a member of the late Scythian Chios fauna. Each of the two species of this genus recognized by Renz and Renz was based on a single specimen; I can see no significant difference between these two specimens.

Occurrence. Subcolumbites fauna of Chios.

Repository. Holotype of *Beyrichites laurae*, NHMB J13712, holotype of *B. praematurus*, NHMB J13711.

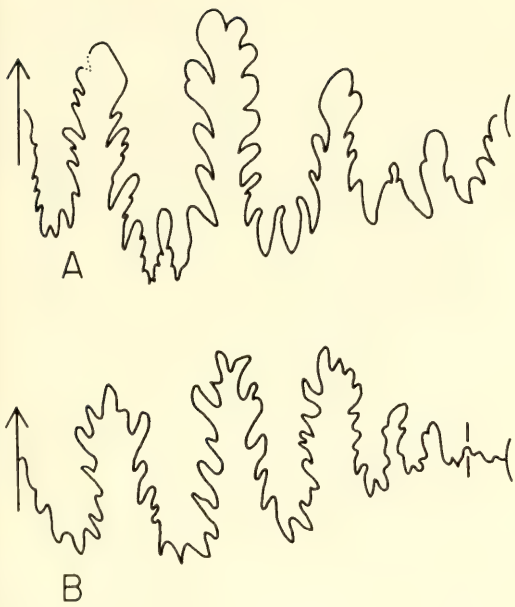

Figure 45. Diagrammatic representation of the suture of: A, *Eogymnites arthaberi* (Diener), from holotype, at a diameter of 75 mm, from *Subcolumbites* fauna of Albania; B, *Beyrichites laurae* Renz and Renz (1948: pl. 8, fig. 1b), at a diameter of 42 mm, from *Subcolumbites* fauna of Chios (NHMB J13712).

Superfamily PINACOCERATACEAE Mojsisovics, 1879

Family GYMNITIDAE Waagen, 1895

Genus *Eogymnites* Spath, 1951

Type species, *Japonites arthaberi* Diener, 1915

Eogymnites arthaberi (Diener)
Plate 21, figures 1, 2; Text-figure 45

Japonites sugriva Diener var. Arthaber, 1911: 231, pl. 20(4), fig 4.
Japonites arthaberi Diener, 1915: 158 (= *J. sugriva*,—Arthaber non Diener); Kummel, *in* Arkell et al., 1957: L185, fig. 214,4.
Japonites decipiens Spath, 1951: 172 (= *J. sugriva*,—Arthaber non Diener).

Arthaber's type and only specimen of this unusual Scythian species is only modestly well preserved, consisting mainly of phragmocone; the adoral 30 mm is body chamber. The specimen measures approximately 89 mm in diameter, 23.4 mm for the width of the adoral whorl, 29 mm for the height, and 36.4 mm for the diameter of the umbilicus. The whorls are compressed with convex whorl sides converging to a narrowly rounded venter. The maximum width is at the umbilical shoulder. The umbilical wall is low, rounded, and slopes to the umbilical seam at a steep angle. The shell is preserved only in part, and very poorly; it is apparently smooth except for slightly sinuous growth lines.

Spath (1951: 172) expressed concern over Arthaber's (1911: pl. 20(4), fig. 4c) illustration of the suture. A new drawing made from the type specimen is illustrated here on Figure 45A. As with nearly all the specimens from the *Subcolumbites* fauna from Albania and Chios, the suture can be developed only by grinding. The suture illustrated here I believe to be a fairly accurate representation and does not differ from that reproduced by Arthaber to any significant degree.

There is no other Scythian ammonoid comparable to this species.

Occurrence. *Subcolumbites* fauna, Kčira, Albania.

Repository. Paleontological Institute, University of Vienna.

Family HUNGARITIDAE Waagen, 1895

Genus *Prohungarites* Spath, 1934

Type species, *Prohungarites similis* Spath (= *Hungarites* cf. *middlemissii* Diener,—Welter, 1922)

Prohungarites crasseplicatus (Welter)
Text-figure 46

Hungarites crasseplicatus Welter, 1922: 147, pl. 168(14), figs. 1–6.
Prohungarites crasseplicatus,—Spath, 1934: 244; Spath, 1951: 20; Kummel, 1961: 525.
Hungarites cf. *middlemissii* Diener,—Welter, 1922: 146, pl. 13, figs. 6–9, 18.
Prohungarites similis Spath, 1934: 327; Spath, 1951: 19; Kummel, *in* Arkell et al., 1957: L155, fig. 186,7.

It was for this morphologic group from Timor that Spath (1934) introduced the genus *Prohungarites*. Welter (1922) had included in the genus *Hungarites* three

species from the blocks with manganese coated fossils from Nifoekoko, Timor; these were cf. *middlemissii* Diener, *crasseplicatus* and *tuberculatus*. Spath (1934: 327) introduced the species name *similis* for cf. *middlemissii*,—Welter (non Diener). The first two of these species are combined here. They were originally separated merely on differences in the intensity of the ribbing. Even Welter (1922: 147) discussed the gradational aspects of the species and illustrated one specimen (Welter, 1922: pl. 167(13), figs. 10, 11) as a transitional form between *P. middlemissii* and *P. crasseplicatus*. Restudy of Welter's types show that his descriptions and illustrations are quite adequate. The measurements of Welter's types are as follows:

	D	W	H	U	W/D	H/D	U/D
1.	58.5	17.5	23.4	15.1	29.9	40.0	25.8
2.	38.7	14.2	16.5	10.6	36.7	42.6	27.4
3.	36.1	11.5	15.0	10.5	31.9	41.6	29.1
4.	35.4	11.4	16.0?	8.2?	32.2	45.2?	23.2?
5.	33.6	11.9	13.2	11.2	35.4	39.3	33.3
6.	30.0	10.1	11.9	9.5	33.7	39.7	31.7

1. Welter (1922: pl. 13, figs. 6–9) GPIBo 226a.
2. Welter (1922: pl. 14, figs. 1–3) GPIBo 228a.
3. Welter (1922: pl. 13, figs. 10–11) GPIBo 227.
4. Welter (1922: pl. 13, fig. 18) GPIBo 226b.
5. Welter (1922: pl. 14, figs. 4, 5) GPIBo 228b.
6. Welter (1922: pl. 14, fig. 6) GPIBo 228c.

The upper part of the Thaynes Formation along Hammond Creek in southeastern Idaho has yielded about 30 poorly preserved specimens which are very similar to the Timor *P. crasseplicatus*. The whorls of the Idaho species are fastigate only on the early volutions. The mature volutions have rounded venters. The slightly sinuous ribs on most of the specimens are comparable to those on Welter's transitional specimen between *P. similis* and *P. crasseplicatus* but are prosiradiate, not radial. The largest specimen, approximately 65 mm in diameter, consisting of a half volution of body chamber, has the blunt lateral ribs like Welter's *P. crasseplicatus* (Welter, 1922: pl. 14, figs. 1–3). The sutures in the Timor and Idaho specimens are likewise similar (Fig. 46).

Occurrence. The specimens from Timor came from the limestone with manganese coated fossils, Nifoekoko.

Repository. Holotype *P. similis* Spath (= *Hungarites* cf. *middlemissii*,—Welter, 1922: pl. 13, figs. 6–9) GPIBo 226a; paratype, *Hungarites* cf. *middlemissii*,—Welter (1922: pl. 13, fig. 18) GPIBo 226b; syntype *P. crasseplicatus* (Welter, 1922: pl. 14, figs. 1–3) GPIBo 228a, (pl. 14, figs. 4, 5) GPIBo 228b, (pl. 14, fig. 6) GPIBo 228c; Welter's transitional specimen (1922: pl. 13, figs. 10, 11) GPIBo 227.

Prohungarites cf. *crasseplicatus* (Welter)

Prohungarites cf. *crasseplicatus*,—Kummel, 1966: 400, pl. 3, figs. 11, 12.

Four small phragmocones from West Pakistan differ from the Timor *P. crasseplicatus* principally in the absence of any indication of a keel along the central part of the venter on the mature whorls. In all other conch features, such as shape of the whorl section, shape of the ventral and umbilical shoulders, and nature of the umbilical wall, it is very similar. The suture is likewise essentially the same. The other Timor species, *Prohungarites tuberculatus*, is more robust with a more highly developed ornamental pattern. There is a strong morphological similarity to *Prohungarites gutstadti* n. sp. from the Upper Thaynes Formation of southeast Idaho. Both species have acute venters only on the earliest volutions and rounded venters on the later volutions.

Occurrence. Narmia Member of the Mianwali Formation, Narmia Nala, Surghar Range, West Pakistan.

Repository. MCZ 9606, 9607.

Prohungarites tuberculatus (Welter)

Text-figure 46

Hungarites tuberculatus Welter, 1922: 148, pl. 167(13), figs. 12–17.

Prohungarites tuberculatus,—Spath, 1934: 244; Kummel, 1961: 525.

The basic form of the conch in this species is very much like *P. crasseplicatus*

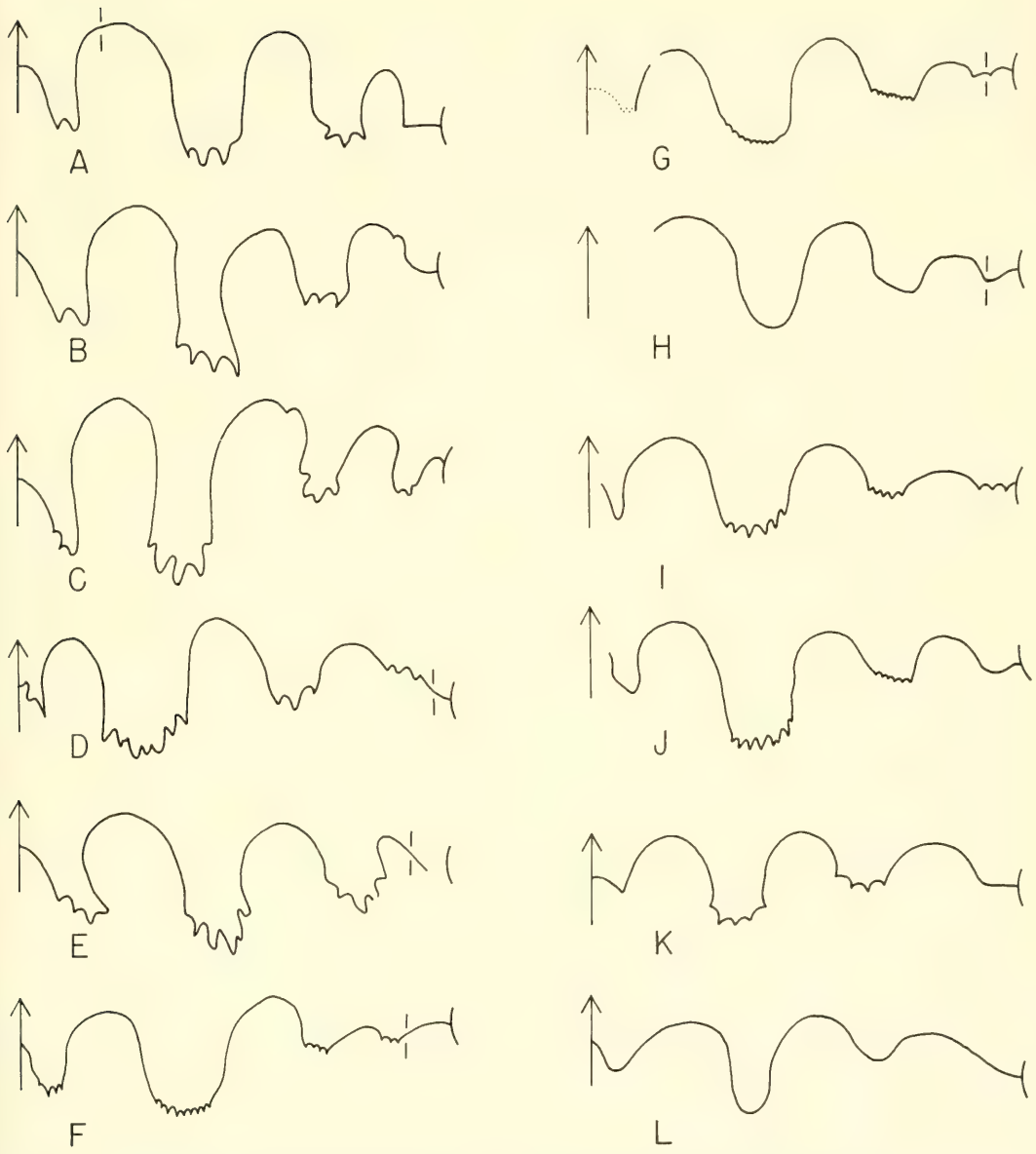

Figure 46. Diagrammatic representation of the suture of: A, *Hungarites* cf. *middlemissii* Diener,—Welter (1922: pl. 13, fig. 18), from Block E, Nifoekoko, Timor; B, *Hungarites crasseplicatus* Welter (1922: pl. 14, fig. 6), from Block E, Nifoekoko, Timor; C, *Hungarites tuberculatus* Welter (1922: pl. 13, fig. 12), from Block E, Nifoekoko, Timor; D, *Kiparisovites carinatus* Astakhova (1964: 379, fig. 1d), from *Doricranites* Zone of Astakhova, Mangyshlak Peninsula; E, *Prohungarites* (?) *popovi* Kiparisova (1961: fig. 113), from Anisian strata of the Primorye Region, at a whorl height of 13 mm; F, *Prohungarites mckelvei* n. sp. from Upper Thaynes Formation, Hammond Creek, southeast Idaho, at a whorl height of 17 mm (MCZ 9646); G, *Prohungarites gutstadti* n. sp., from Upper Thaynes Formation, Hammond Creek, southeast Idaho, at a whorl height of 13 mm (holotype MCZ 9475); H, *Prohungarites* sp. indet., from Upper Thaynes Formation, Hammond Creek, southeast Idaho, at a whorl height of 15 mm (MCZ 9648); I, *Prohungarites* sp. indet., from Upper Thaynes Formation, Hammond Creek, southeast Idaho, at a whorl height of 26 mm; J, *Dalmatites morlaccus* Kittl (1903: pl. 4, fig. 6), from Werfen Formation, Dalmatia; K, *Dalmatites kittli* n. sp., from *Columbites* Zone, Paris Canyon, southeast Idaho, at a whorl height of 10 mm (MCZ 9499).

except that it is more evolute and the whorls more inflated. The big difference in these species is in the ornamentation. This species has coarse, conspicuous ribs with a node just above the umbilical shoulder. This pattern of ornamentation commences at an early growth stage, as can be seen in the umbilical region of Welter's holotype and in the small specimen illustrated by Welter (1922: pl. 13, figs. 16, 17). The measurements of Welter's two specimens are as follows:

D	W	H	U	W/D	H/D	U/D
47.5	16.6	18.0	17.5	34.9	37.9	36.8
7.3	?	2.5	2.8	?	34.2	38.4

The first of these measurements is for the holotype and the second is for the paratype.

The suture is illustrated on Figure 46C.

Occurrence. In the limestone with black manganese coated fossils, Nifoekoko, Block E, Timor.

Repository. Holotype GPIBo 229a; paratype GPIBo 229b.

Prohungarites middlemissii (Diener)
Plate 25, figures 3–8

Hungarites middlemissii Diener, 1913: 23, pl. 3, figs. 5–7; Diener, 1915: 153; Spath, 1934: 33. *Prohungarites middlemissii*,—Kummel, 1961: 525.

Diener (1913) stated he had approximately 40 specimens of this species collected from a loose block at Pastannah, Kashmir. Of these only the three figured syntypes (Diener, 1913: pl. 3, figs. 5–7) are preserved in the collection of the Geological Survey of India. The disposition of the other specimens is not known.

Even though the suture is unknown, the general conch morphology clearly indicates that this is a valid species of *Prohungarites*. In the degree of involutions and ornamentations, it is quite similar to *P. mckelvei* but is unique in the widening of the ventral part of the whorl in the mature stages and in the acquisition of nodes on the ribs. *Prohungarites crasseplicatus* has a much more robust whorl section, is more evolute, and has more pronounced ornamentation. This species strongly suggests the presence of a horizon younger than the *Hedenstroemia* beds in Kashmir. Final evaluation on the biologic affinities of this species and its stratigraphic position will have to await new field investigations and collections.

Occurrence. Loose block, Pastannah, Kashmir.

Repository. Syntype (Diener, 1913: pl. 3, fig. 5) GSI 11276, (pl. 3, fig. 6) GSI 11277, (pl. 3, fig. 7), GSI 11278.

Prohungarites carinatus (Astakhova)
Text-figure 46

Kiparisovites carinatus Astakhova, 1964: 379, pl. 1, fig. 1.

This is clearly a species of *Prohungarites* of the general form of *P. mckelvei* and *P. crasseplicatus*; just why its author introduced a new genus for her two fragmentary specimens is hard to tell. The suture is shown on Figure 46D.

Occurrence. Doricranites Zone (of Astakhova, 1960a, b), Mangyshlak Peninsula, Karatauchik Range.

Prohungarites mckelvei n. sp.
Plate 35, figures 1–5, 8, 9; Text-figure 46

Prohungarites n. sp. cf. *P. similis*,—Kummel, 1954: 187.

This is the most common species in the upper member of the Thaynes Formation at Hammond Creek, Bear River Range, southeast Idaho. The collection contains a couple of hundred specimens, most of which, however, are not well preserved. In addition, the Tobin Formation, Tobin Range, Nevada, has yielded 10 fragmentary and poorly preserved specimens.

The conch is involute, compressed, with a distinct knife-edged venter. A remarkable feature of this species is the high degree of constancy in basic conch proportions. The venter has a distinct fastigate appearance except that the ventral shoulders are

rounded and not angular. The lateral areas are broadly convex. The umbilical shoulder is acutely rounded and the umbilical wall is vertical.

The conch is essentially smooth, except for extremely faint, moderately spaced, falcoid ribs. Within the small umbilicus only the umbilical shoulders and wall of the preceding volutions are visible. No ornamentation of any kind is visible in the umbilical area.

The suture is shown on Figure 46F.

This new Idaho species displays some morphological similarity to *Prohungarites crasseplicatus* from the manganese coated beds of Nifoekoko, Timor, but a more marked similarity to *Prohungarites middlemissii* from an unknown horizon in Kashmir. The Timor species (*P. crasseplicatus*) is more inflated, more evolute, with sharper ventral shoulders, and with a tendency towards more robust ornamentation. In spite of these differences, the morphological relationships of *P. mckelvei* and *P. crasseplicatus* are very close. The Kashmir species (*P. middlemissii*) differs mainly in that on the outer volutions the greatest width of the whorls shifts to the region of the ventral shoulders. The degree of involution, the subdued falcoid ribs, and nature of the venter are strikingly similar to *P. mckelvei*. My specimens from the Tobin Formation, though poorly preserved and fragmentary, cannot be separated from the Idaho forms. N. J. Silberling of the U.S. Geological Survey has kindly shown the author some specimens of *Prohungarites* he collected from the lower part of the Tobin Formation, Tobin Range, Nevada (U.S.G.S. locality 2565). These specimens are very much like the species described here but are slightly more inflated in whorl section; they possibly represent a new species.

Occurrence. Upper member of Thaynes Formation, Hammond Creek, Bear River Range, southeast Idaho; upper part Tobin Formation, Tobin Range, Nevada.

Repository. Specimens from Hammond Creek: Holotype MCZ 9466 (Pl. 35, figs. 1, 2); figured paratypes MCZ 9467 (Pl. 35, fig. 3, 4), MCZ 9468 (Pl. 35, fig. 5), MCZ 9469 (Pl. 35, figs. 8, 9); unfigured paratypes MCZ 9646; unfigured specimens from Tobin Formation, MCZ 9651.

Prohungarites gutstadti n. sp.

Plate 36, figures 3, 14, 15; Text-figure 46

Prohungarites cf. *crasseplicatus* Kummel, 1954: 187; Kummel, 1966: 400.

This species is represented by 30 or more specimens most of which, unfortunately, are poorly preserved. This species has the general conch form of *P. crasseplicatus*. It differs in that the venter on the mature volutions is rounded and not fastigate. A blunt sharpened venter is present up to a diameter of approximately 15 mm, as seen in the specimen of Plate 36, figures 14, 15, but at some stage after that the venter becomes rounded. The second major difference is that the ribs are prosiradiate and not radial. The range of ribbing pattern is much the same in the two species. The suture is shown on Figure 46G.

This species is remarkably similar to the specimens assigned to *Prohungarites* cf. *crasseplicatus* from the Narmia Member of the Mianwali Formation in the Surghar Range of West Pakistan (Kummel, 1966). In that species the sharpened venter likewise is confined to the earlier volutions, the more mature volutions having a rounded venter. The ribs in the Pakistan species are radial rather than prosiradiate. The restriction of the sharpened venter to the earliest volutions differentiates these two species from all others assigned to *Prohungarites*.

Occurrence. Upper Thaynes Formation, Hammond Creek, Bear River Range, southeast Idaho.

Repository. Holotype MCZ 9475 (Pl. 36, fig. 3); figured paratype MCZ 9481 (Pl. 36, figs. 14, 15); unfigured paratypes MCZ 9645.

Prohungarites sp. indet.

Plate 38, figures 4, 5; Text-figure 46

The collections from the Hammond Creek locality of the Thaynes Formation, and from the upper part of the Tobin Formation in the Tobin Range, Nevada, contain, in association with *Prohungarites mckelvei*, several poorly preserved fragments that are clearly a new and distinctive species of ammonite. However, because of the fragmentary nature of the specimens no new name is introduced. The whorls are very rapidly expanding with radial to slightly prosiradiate ribs that are greatly enlarged in the general region of the umbilical shoulder. The venter is fairly broad and fastigate. The suture is shown on Figure 46H, I.

This form is completely different from the associated *Prohungarites mckelvei* and *Prohungarites gutstadti* and is quite different from the other species of *Prohungarites* reported to date. The pattern of ribbing and the rapidly expanding whorls at first suggested a relationship to *Arctoprionites*. In that genus, however, in so far as we know, the venter is truncate and never fastigate. The suture of the form recorded here is more prohungaritid in aspect.

Occurrence. Upper Thaynes Formation, Hammond Creek, Bear River Range, southeast Idaho; upper Tobin Formation, south end Tobin Range, Nevada.

Repository. Figured specimens from southeast Idaho MCZ 9474 (Pl. 36, figs. 1, 2), MCZ 9647 (Pl. 38, figs. 4, 5); unfigured specimens from southeast Idaho MCZ 9648; specimens from Tobin Range MCZ 9652.

Genus *Dalmatites* Kittl, 1903

Type species, *Dalmatites morlaccus* Kittl, 1903

Dalmatites morlaccus Kittl

Plate 56, figures 1–8; Text-figure 46

Dalmatites morlaccus Kittl, 1903: 73, pl. 4, figs. 3–7; Diener, 1915: 115; Spath, 1951: 20; Kummel, *in* Arkell, et al., 1957: L156, fig. 187, 7.

The four specimens of this species illustrated by Kittl (1903: pl. 4, figs. 4–7) are still preserved. The photographs of these type specimens reproduced here on Plate 56 show that the preservation is no more than fair to poor. The measurements of these four specimens are as follows:

	D	W	H	U	W/D	H/D	U/D
1.	69.0	15.6	39.0	5.1	22.6	56.5	7.4
2.	53.0	10.0?	27.1	2.7	18.9?	51.1	5.1
3.	49.1	8.4	27.1	3.0	17.1	55.2	6.1
4.	43.0	9.3	23.0?	?	21.6	53.5?	?

1. Paralectotype, Kittl (1903: pl. 4, fig. 7).
2. Paralectotype, Kittl (1903: pl. 4, fig. 6).
3. Lectotype, Kittl (1903: pl. 4, fig. 4).
4. Paralectotype, Kittl (1903: pl. 4, fig. 5).

The suture is reproduced here in Figure 46J.

This species is known only from the Werfen Formation of Europe. The only other species of this genus, *D. kittli*, is known only from a single specimen from the *Columbites* fauna of southeastern Idaho. The two species are very similar.

Occurrence. Werfen Formation, Muć, Dalmatia.

Repository. Natural History Museum, Vienna.

Dalmatites kittli n. sp.

Plate 55, figures 7, 8; Text-figure 46

This species is established on a single specimen from the *Columbites* fauna of southeastern Idaho. The conch is smooth, compressed, involute, and is entirely phragmocone. It measures 33.5 mm for the width of the last whorl, and the umbilicus is 3.8 mm in diameter. The venter is acute, the lateral areas broadly convex. The broadest part of the whorl is in the mid-area of the whorl. The umbilical shoulder is rounded with a fairly steep umbilical wall. The conch is smooth except for growth lines. The pattern of the growth lines, however, is not visible due to faulty preservation of the shell.

The suture is illustrated on Figure 46K. It is of a fairly simple pattern with two lateral lobes, and an auxiliary lobe on the

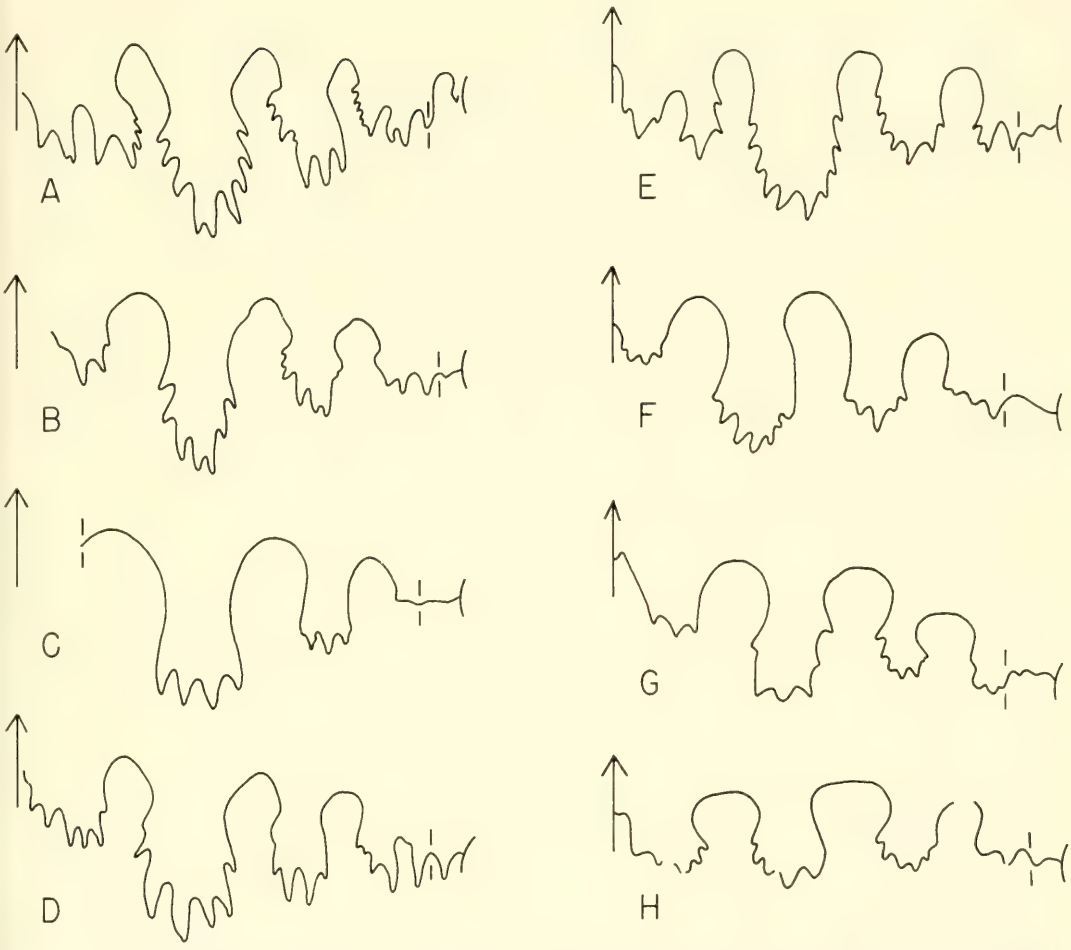

Figure 47. Diagrammatic representation of the sutures of three species of *Eophyllites*. A–F, *Eophyllites dieneri* (Arthaber); A, paralectotype (Arthaber, 1908: fig. 4), new drawing at a diameter of 42 mm; B, plesiotype (Arthaber, 1911: pl. 20(4), fig. 6), new drawing at a diameter of 47 mm; C, type specimen of *Monophyllites kingi*,—Arthaber (non Diener) = *Ussurites* (?) *decipiens* Spath (1934), at a diameter of approximately 30 mm; this suture is highly distorted due to excessive grinding of the specimen; D, holotype of *Monophyllites nopcsai* Arthaber (1908: pl. 12, fig. 5), new drawing at a diameter of 28 mm; E, holotype of *Monophyllites* (*Schizophyllites*) *betilloni* Renz and Renz (1948: pl. 4, fig. 8b), at a diameter of 47 mm; F, plesiotype (Renz and Renz, 1948: pl. 5, fig. 1b), at an unknown diameter. G, *Eophyllites orientalis* Spath,—Welter (1922: pl. 161(7), fig. 7), at an unknown diameter. H, *Eophyllites amurensis* Kiparisova (1961: text-fig. 104), at a whorl height of 10 mm.

Specimens of A–D from *Subcolumbites* fauna of Albania; E, F, from same fauna on Chios; G, from Nifoekoko, Block E, Timor; H, from *Subcolumbites* fauna, Primorye Region, Siberia.

dorsal areas of the flanks. It is difficult to be sure whether the lobes are really goniatitic as shown on Figure 46K. There are faint indications of denticulations on some of the first and second lateral lobes, and I suspect the smooth aspect is due to poor preservation.

Dalmatites morlaccus Kittl is morphologically very similar to *D. kittli*. The venter on the type species becomes rounded on the body chamber and the suture shows minor differences in proportion and shape of the elements.

Occurrence. Middle shale member of

Thaynes Formation (*Columbites* fauna), Paris Canyon, Bear River Range, Southeast Idaho.

Repository. Holotype, MCZ 9499.

Dalmatites attenuatus Smith

Plate 71, figures 8, 9;

Dalmatites attenuatus Smith, 1932: 81, pl. 57, figs. 11–13.

A highly compressed dalmatitid with a sharp venter. It is more compressed than either *D. morlaccus* or *D. kittli* and in addition more evolute. The suture is on the same basic pattern as the other species.

Occurrence. Smith's holotype came from the *Tirolites* Zone in Paris Canyon, southeast Idaho. He reports (Smith, 1932: 81) that he had only one specimen from the *Tirolites* Zone of Idaho but in addition he states the species was also found in the *Meekoceras* Zone at Phelan ranch, mouth of Cottonwood Canyon, east of the Ruby Range, Nevada; however, this latter specimen (or specimens?) is apparently no longer preserved. Smith (1932: 81) did describe a species—*D. richardsi*—from the *Meekoceras* Zone.

Repository. Holotype USNM 75023.

Order PHYLLOCERIDA Arkell, 1950

Superfamily PHYLLOCERATACEAE Zittel, 1884

Family USSURITIDAE Hyatt, 1900

Genus *Eophyllites* Spath, 1930

Type species, *Monophyllites dieneri* Arthaber, 1908

Eophyllites dieneri (Arthaber)

Plate 22, figures 1–4; Plate 23, figures 1–7; Text-figure 47

Monophyllites dieneri Arthaber, 1908: 288, pl. 13(3), figs. 3a–c, 4a–c; Arthaber, 1911: 234, pl. 20(4), figs. 5–8; Diener, 1915: 203.

Eophyllites dieneri,—Spath, 1930: 89; Spath, 1934: 293–295; Kummel, *in* Arkell et al., 1957: L186.

Monophyllites hara,—Arthaber (non Diener), 1908: 286, pl. 12(2), figs. 4a–c; Arthaber, 1911: 235.

Monophyllites (*Ussurites*) *hara* Diener, 1915: 206.

Eophyllites refractus Spath, 1934: 295, pl. 3, fig. 4.

Monophyllites kingi,—Arthaber (non Diener), 1911: 235, pl. 20(4), figs. 12a–c.

Monophyllites (*Ussurites*) *kingi* Diener, 1915: 207.

Ussurites (?) *decipiens* Spath, 1934: 302 (= *Monophyllites kingi,*—Arthaber non Diener).

Monophyllites nopcsai Arthaber, 1908: 287, pl. 12(2), figs. 5a–c; Arthaber, 1911: 235; Diener, 1915: 203.

Eophyllites nopcsai,—Spath, 1934: 302.

Monophyllites (*Leiophyllites*) *rosae* Renz and Renz, 1947: 61, 77; Renz and Renz, 1948: 74, pl. 3, figs. 8–8a.

Monophyllites (*Schizophyllites*) *betilloni* Renz and Renz, 1947: 61, 78; Renz and Renz, 1948: 76, pl. 4, figs. 8–8b.

Monophyllites (*Schizophyllites*) *betilloni* var. *evoluta* Renz and Renz, 1948: 76, pl. 4, figs. 6–6a, pl. 5, figs. 2–2a, 4–4a, 6–6a.

The lectotype of this species is not in the collections of the Paleontological Institute, University of Vienna, and is presumed lost. Two figured paralectotypes are available, but none of the unfigured specimens noted by Arthaber. The one figured paralectotype (Arthaber, 1908: pl. 13(3), figs. 4a–c; 1911: pl. 20(4), figs. 5a–c; Pl. 23, figs. 2, 3 of this report) is mainly phragmocone. The lateral area of the illustrated side has been polished to expose the sutures, but at the same time this has destroyed all surface markings. The opposite side of the conch is all matrix or highly weathered. This specimen measures 49.5 mm in diameter, 20.6 mm for the height of the last whorl and 15.7 mm for the diameter of the umbilicus. The unretouched photograph of Plate 23, figures 2, 3 shows the main features of the conch and the general state of preservation of the specimen better than the retouched illustration of Arthaber.

The second paralectotype is the specimen which yielded the suture of Arthaber's plate 20(4), figure 6 and is illustrated here on Plate 23, figures 4, 5. It is a fragmentary specimen that is nearly all phragmocone. Much of the lateral area has been ground to expose the suture (Fig. 47B).

Monophyllites hara,—Arthaber, non Diener (1908: 286, pl. 12(2), fig. 4), renamed *Eophyllites refractus* by Spath (1934: 295) is unfortunately not preserved in the collections of the Paleontological Institute, University of Vienna. There are, however, several topotypes in the British Museum (Natural History). The species was characterized mainly by its broader venter. Spath (1934: 295) also mentions differences with *Eophyllites dieneri* in the pattern of the growth lines. In regard to the width of the venter, Spath himself stated that among the topotypes he had, they could not be distinguished satisfactorily from *E. dieneri*. As yet too few specimens of *Eophyllites* from Albania have been studied, but it does not seem likely that differences in the character of the venter as used in this case are anything more than the normal type of variation one can expect and can demonstrate in many cases within ammonite species. *Eophyllites refractus* is believed to be conspecific with *E. dieneri*.

Ussurites (?) *decipiens* Spath (1934) (= *Monophyllites kingi*,—Arthaber, 1911: pl. 20(4), fig. 12) is likewise believed to be a specimen of *E. dieneri*. Proper understanding of this species (and specimens) has not been possible on the basis of Arthaber's illustrations, especially of the suture. In the first place the type specimen (Plate 23, figures 6, 7) has the same general shape, etc., as the types of *E. dieneri*. The measurements are: diameter 50.8 mm, width of last whorl 12.0? mm, height of last whorl 18.8 mm, and width of umbilicus 18.3 mm. One of the most conspicuous differences is that *decipiens* is more evolute than *dieneri*; this difference, however, amounts to only 5 percent of the conch diameter and this is hardly a criterion of specific significance. The whorls are slightly more inflated than in *decipiens* and the venter is more broadly rounded than indicated by Arthaber's (1911: pl. 20(4), fig. 12b) drawing. The whorl cross-section is intermediate between that of *E. decipiens* and *E. refractus*. The adoral quarter volution is marked by fine radial lines some of which at intervals are more conspicuous than others. The general absence of these lines on the two available specimens of *decipiens* is due to preservation plus grinding of the surface of the conch.

It is in the suture, however, that most authors recognized significant differences. As with practically all of the Albanian material, the suture can be made visible only by grinding and polishing of the surface. Arthaber's type specimen had been ground for this purpose and in this case the grinding was far too much, destroying many of the details of the lobe denticulations. Faint outlines of denticulations are visible on the lower flanks of the lobes. Arthaber's suture (1911: pl. 20(4), fig. 12c) actually ends on the umbilical shoulder and does not include anything for the umbilical wall. The suture on the umbilical wall is, however, not preserved. The relative shortness of the suture line reflects the difference in degree of involution and whorl height. The suture of *decipiens* illustrated by Arthaber came from a whorl height of 10.5 mm; the suture of *dieneri* (Arthaber, 1911: pl. 20(4), fig. 5) came from a whorl height of 17 mm. All of the above data clearly point to *Ussurites decipiens* as being part of the *dieneri* complex.

Eophyllites nopcsai (Arthaber), which is associated with *E. dieneri* in the Albanian fauna, is based on a single specimen; this is illustrated here on Plate 22, figures 1, 2. In suture (Fig. 47D) and ornamentation it is very much like *E. dieneri*, but its conch is very involute; its umbilicus is only 25 percent the diameter of the conch whereas in *dieneri* the umbilicus measures 30–36 percent the diameter of the conch. The association of this form in the same beds with *E. dieneri* and the very close similarity in all other conch features leads me to conclude that *nopcsai* represents nothing more than a variant toward involution of the conch, as *decipiens* represents a variant

in the opposite direction—that is, a more evolute conch.

The *Subcolumbites* fauna of Chios contains an interesting assemblage of specimens assigned to other species which I believe are conspecific with the Albanian *E. dieneri*. The specimens which Renz and Renz (1948: 74) named *Monophyllites* (*Leiophyllites*) *rosae* I cannot separate from *E. dieneri*. The specimens assigned by Renz and Renz (1948: 76) to *Monophyllites* (*Schizophyllites*) *betilloni* were set aside into a new subgenus on the basis of a slight saddle in the ventral lobe. The suture of the subgenotype (Fig. 47E) is nearly identical to that of the suture of the paralectotype of *E. dieneri* (Fig. 47A). Spath (1934: 294) had earlier called attention to the variability in the suture of *E. dieneri* and especially to the ventral lobe. He also rightly cautioned that some of this variability is caused by preparation of the suture with acids and grinding. In all other features *betilloni* resembles *E. dieneri*, and there appears little doubt but that these two species are conspecific.

The form from Timor described by Welter (1922: 118, pl. 161(7), figs. 5–7) as *Monophyllites* nov. sp. ex aff. *dieneri* was renamed *Eophyllites orientalis* by Spath (1934: 295). This species is based on a single incomplete specimen that represents the inner whorls of what was a much larger form. It is unquestionably very close to *E. dieneri* and possibly even conspecific, but here again, since it is based on a single specimen, it is considered best for the moment to recognize it as a distinct species.

Occurrence. *Subcolumbites* fauna of Kčira, Albania, and Chios.

Repository. The Paleontological Institute, University of Vienna, contains two paralectotypes of *E. dieneri*; the lectotype is apparently lost. This collection also contains the holotype of *Ussurites* (?) *decipiens* Spath (= *Monophyllites kingi*,—Arthaber non Diener). A number of topotypes are in the British Museum (Natural History), C22939–47, C22979. The Natural History Museum, Basel, contains the following specimens from the *Subcolumbites* fauna of Chios: holotype *Monophyllites* (*Leiophyllites*) *rosae* Renz and Renz (1948: pl. 3, fig. 8) NHMB J13746; holotype *Monophyllites* (*Schizophyllites*) *betilloni* Renz and Renz (1948: pl. 4, fig. 8) NHMB J13756; var. *evoluta* Renz and Renz (1948: pl. 4, fig. 6) NHMB J13757, (pl. 5, fig. 2) NHMB J13758, (pl. 5, fig. 4) NHMB J13759, (pl. 5, fig. 6) NHMB J13760; unfigured paratypes from Maradavuno, NHMB J13761, from Kephalovuno NHMB J13762.

Eophyllites orientalis Spath

Text-figure 47

Monophyllites nov. spec. ex aff. *dieneri*,—Welter, 1922: 118, pl. 161(7), figs. 5–7; Kutassy, 1933: 595.

Eophyllites orientalis Spath, 1934: 295.

This Timor species is based on a single specimen that represents the inner whorls of what was a much larger form. The specimen measures 56.7 mm in diameter, 16.0 mm for the width of the last whorl, 23.0 mm for the height of the last whorl, and 19.1 mm for the diameter of the umbilicus. It shows a great similarity to *E. dieneri* of Albania and Chios and perhaps is conspecific with that form. However, because only one specimen is known and because there are minor differences in the suture (Fig. 47G) and conch features, it is considered best to maintain the separate identity of this species until more material becomes available.

Occurrence. Manganese coated blocks from Nifoekoko, Timor.

Repository. GPIBo-W215.

Eophyllites amurensis Kiparisova

Text-figure 47

Eophyllites amurensis Kiparisova, 1961: 137, pl. 28, figs. 7, 8, text-fig. 104.

Eophyllites cf. *refractus*,—Kiparisova, 1961: 136, pl. 28, fig. 9, text-fig. 103.

The two forms of *Eophyllites* recognized by Kiparisova from the Primorye Region

represent an inflated form (cf. *refractus*) and a more compressed form (*amurensis*). The latter species was compared closely with *dieneri* from the *Subcolumbites* fauna of Albania. One of these species (cf. *refractus*) is based on a single specimen and the other (*amurensis*) was based on three poorly preserved specimens. They are in the first place considered to represent a single species complex. These specimens differ from *E. dieneri* in being slightly more involute and in the slightly simpler structure. They are clearly closely related to the *dieneri* group of Albania and could well be conspecific but much more material is needed before this relationship can be established with any degree of certainty.

Occurrence. The three specimens of *amurensis* came from the *Subcolumbites* fauna on the west coast of Amur Bay between Cape Atlasov and Cape Ugolny, Ussuri Bay, Primorye Region. The single specimen assigned by Kiparisova to cf. *refractus* came from the east coast of Ussuri Bay between Cape Kom-Pikho-Sakho and Cape Chigan from an uncertain horizon.

Genus *Palaeophyllites* Welter, 1922

Type species, *Palaeophyllites steinmanni* Welter, 1922

Palaeophyllites steinmanni Welter

Palaeophyllites steinmanni Welter, 1922: 119, pl. 162(8), figs. 5, 6, 7, pl. 163(9), figs. 3–6; Kutassy, 1933: 606; Spath, 1934: 297, fig. 103.
Monophyllites (*Palaeophyllites*) *thalmanni* Renz and Renz, 1947: 61, 78; Renz and Renz, 1948: 79, pl. 3, figs. 10–10b (= *Palaeophyllites steinmanni* Welter, 1922: pl. 163(9), figs. 3–6 (non pl. 162(8), figs. 5–7).
Monophyllites (*Palaeophyllites*) *praekieperti* Renz and Renz, 1947: 61, 78; Renz and Renz, 1948: 80, pl. 4, figs. 5–5b.

Renz and Renz (1948) established the species *thalmanni* for the specimen illustrated by Welter on his plate 163(9), figures 3–6, at the same time designating the specimen of Welter's plate 162(8), figures 5, 6, as "holotype." They were unaware that Spath (1934: 298) had previously designated this specimen as lectotype. The smaller specimens of Welter's plate 163(9), figures 3–6, are characterized by a more subdued ribbing pattern. These specimens are clearly juvenile forms; the ornamentation increases on the mature body chamber. The Chios and Timor specimens of "*thalmanni*" are immature forms but clearly conspecific. The species *praekieperti* established by Renz and Renz (1948: 80) is merely a small, juvenile specimen of *steinmanni*. Measurements for 6 specimens from Timor and Chios are given on Table 50.

TABLE 50. MEASUREMENTS OF SPECIMENS OF *PALAEOPHYLLITES STEINMANNI* FROM TIMOR AND CHIOS.

	D	W	H	U	W/D	H/D	U/D
1.	58.8	14.9	20.4	24.5	25.3	34.7	41.7
2.	48.2	12.1	16.4	20.5	25.1	34.0	42.5
3.	40.7	12.0	13.8	16.6	29.5	33.9	40.8
4.	31.5	12.2	10.7	14.3	38.7	34.0	45.4
5.	26.0	8.7	8.7	10.8	33.5	33.5	41.5
6.	23.4	7.9	10.1	7.9	33.8	43.2	33.8

1. Lectotype, Welter (1922: pl.162(8), figs. 5–7), GPIBo W216a.
2. Plesiotype, *Palaeophyllites thalmanni* Renz and Renz (1948: pl. 3, fig. 10), NHMB J13764.
3. Paralectotype, Welter (1922: pl.163(9), figs. 3–4), GPIBo W216b.
4. Holotype, *Monophyllites* (*Palaeophyllites*) *praekieperti* Renz and Renz (1948: pl. 4, fig. 5), NHMB J13766.
5. Paralectotype, Welter (1922: pl.163(9), figs. 5–6), GPIBo W216c.
6. Unfigured specimen from Chios, *Monophyllites* (*Palaeophyllites*) *thalmanni*, NHMB J13765.

Occurrence. *Subcolumbites* fauna of Chios and the *Prohungarites* fauna with manganese coated fossils of Timor.

Repository. Lectotype, GPIBo-W216a; paralectotypes GPIBo-W216b, c; specimens from Chios, plesiotype *Monophyllites* (*Palaeophyllites*) *thalmanni* Renz and Renz (1948: pl. 3, fig. 10) NHMB J13764; unfigured specimen from Maradovuno NHMB J13765, from Kephalovuno NHMB J13836; holotype *Monophyllites* (*Paleophyllites*) *praekieperti* Renz and Renz (1948, pl. 4, fig. 5) NHMB J13766; unfigured paratype NHMB J13767.

Table 51. Measurements of *Ussurites sieveri* n. sp. from Tobin Formation, Nevada.

	D	W	H	U	W/D	H/D	U/D
1.	62.5	20.0	25.8	17.3	32.0	41.2	27.6
2.	48.0	16.4	21.8	13.2	34.1	45.4	27.5
3.	48.0	15.3	21.4	13.7	31.8	44.5	28.5
4.	43.0	14.5?	19.5?	10.0	34.4?	45.3?	23.0
5.	38.7	?	16.5	11.5	?	42.6	29.7
6.	38.4	?	15.5	10.0	?	40.3	26.0
7.	33.5	11.4	14.4	9.3	34.0	42.9	27.7
8.	26.7	10.4	12.3	6.8	38.9	46.0	25.4
9.	25.0	?	11.1	6.4	?	44.4	25.6
10.	21.0	7.8	9.1	6.1	37.2	43.3	29.0
11.	20.6	8.4	9.0	5.7	40.7	43.6	27.6
12.	20.0	7.7	9.0	4.8	38.5	45.0	24.0

1. Holotype, MCZ 9452 (Pl. 32, figs. 1, 2).
3. Paratype, MCZ 9456 (Pl. 32, figs. 6, 7).
4. Paratype, MCZ 9455 (Pl. 32, fig. 5).
5. Paratype, MCZ 9454 (Pl. 32, fig. 4).
6. Paratype, MCZ 9472 (Pl. 35, figs. 10, 11).
10. Paratype, MCZ 9464 (Fig. 48 CD).
2, 6, 7, 9, 11, 12. Unfigured paratypes, MCZ 9484.

Genus *Ussurites* Hyatt, 1900

Type species, *Monophyllites sichoticus* Diener, 1895

Ussurites sieveri n. sp.

Plate 31, figure 8; Plate 32, figures 1–7; Plate 35, figures 10, 11; Text-figure 48

This species is well represented in the Tobin Formation fauna. There are twelve specimens sufficiently well preserved and complete to allow measurements, which are given on Table 51.

The conch is moderately involute with a rounded venter, broadly rounded lateral areas, a well rounded umbilical shoulder, and a vertical umbilical wall. The flanks bear low, narrow, slightly prosiradiate folds that cross the venter.

The sutures from a whorl height of 2.0 mm to a whorl height of 14.8 mm are shown in Figures 48A–D. The suture is typical for the genus, with the asymmetric, club-shaped saddles, the large denticulated first lateral lobe, etc.

This species differs from *Ussurites mansfieldi* n. sp. in conch form and suture. The latter species is quite distinctive in its large asymmetrical second lateral saddle; likewise the ontogenetic changes in the whorl shape are quite different. *Ussurites hosei* n. sp. is a much more robust species, with a more inflated whorl section and a suture with coarser denticulations on the lobes.

Occurrence. Tobin Formation, Pershing County, Nevada; south tip of Tobin Range, Cain Mountain 1:62,500 quad., center NW ¼ sec. 9, T. 26N, R. 39E, 5,500 ft. S, 27.5 ft. W from elevation point 5088 on range crest.

Repository. Holotype MCZ 9452 (Pl. 32, figs. 1, 2); paratypes MCZ 9464 (Pl. 31, fig. 8), MCZ 9453 (Pl. 32, fig. 3), MCZ 9454 (Pl. 32, fig. 4), MCZ 9455 (Pl. 32, fig. 5), MCZ 9456 (Pl. 32, fig. 6, 7), MCZ 9472 (Pl. 35, figs. 10, 11); unfigured paratypes MCZ 9484; suture specimen (Figures 48C, D), MCZ 9464.

Ussurites hosei n. sp.

Plate 33, figures 1–6; Text-figure 48

This new species is based on a fairly large assortment of fragmentary and partially crushed specimens that are, however, so distinctive that a description and new name is warranted. The conch is robust, and moderately involute. None of the specimens are in a state of preservation or completeness to yield any significant measurements. The whorl section is broadly oval and quite variable in relative width-height dimensions. Most of the material shows the whorl width to be approximately 75 per cent of the whorl height, thus slightly compressed. On the other hand, fragments of whorls are present in which the whorl height and width are approximately the same, and in some specimens the whorls are depressed, that is, the whorl width is greater than the whorl height.

The venter is broadly rounded grading onto broadly arched flanks. The umbilical shoulder is rounded, and merges with a broad, nearly vertical umbilical wall. The umbilicus appears to measure approximately 20–25 per cent the diameter of the conch.

None of the specimens are really sufficiently well preserved to show surface

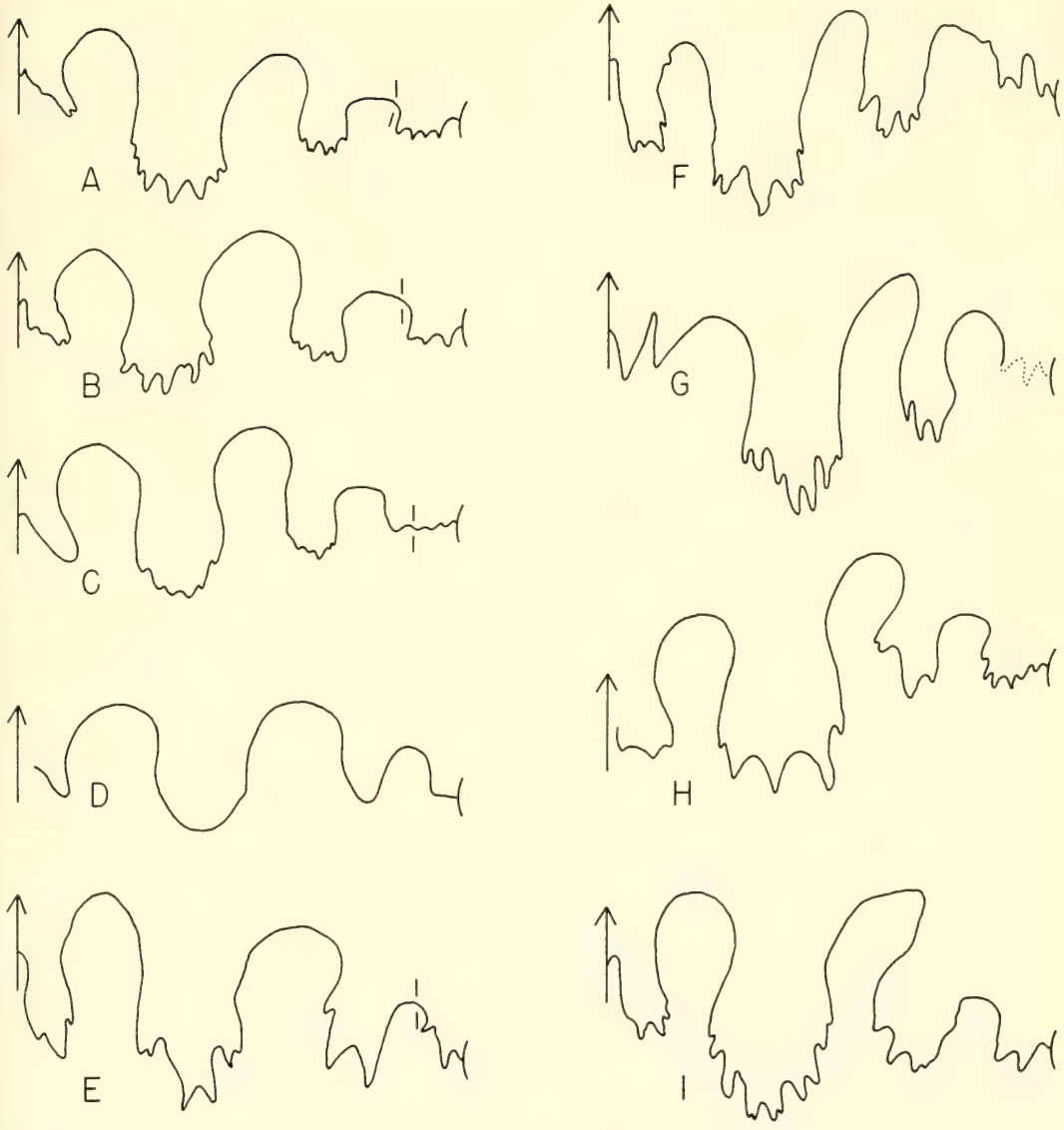

Figure 48. Diagrammatic representations of the suture of: A–D, *Ussurites sieveri* n. sp. A, holotype at a diameter of 35 mm (MCZ 9452); B, paratype at a diameter of 26 mm (MCZ 9472); C, paratype at a diameter of 21 mm; D, at a diameter of 13 mm (MCZ 9464); E, paratype of *Ussurites hoesi* n. sp. at a diameter of 53 mm (USNM 153089); F–I, *Ussurites mansfieldi* n. sp.; F, paratype (Pl. 45, figs. 2, 3), at a diameter of 110 mm; G, at a diameter of 75 mm (MCZ 9515, Pl. 44, fig. 1); H, at a diameter of 43 mm (MCZ 9513, Pl. 44, figs. 2, 3); I, at a diameter of 24 mm (USNM 153090).

Specimens of figures A–D are from Tobin Formation, Nevada, that of figure E from Thaynes Formation, Confusion Range, Nevada, and those of figures F–I, from *Columbites* fauna, Thaynes Formation, southeastern Idaho.

Table 52. Measurements of *Ussurites mansfieldi* n. sp. from the *Columbites* Zone, southeastern Idaho.

	D	W	H	U	W/D	H/D	U/D
1.	203.0	?	93.0	53.0	?	45.8	26.1
2.	126.0	39.5?	53.6	38.0	31.3?	42.5	30.2
3.	48.0	?	24.2	12.8	?	50.4	26.7
4.	43.0	?	20.6	13.6	?	47.9	31.6
5.	37.7	18.0	18.7	11.4	47.7	49.6	30.2

1. Holotype, State Historical Museum, Boise.
2. Paratype, State Historical Museum, Boise.
3. Paratype, MCZ 9513 (Pl. 44, figs. 2, 3).
4, 5. Paratypes, USGS.

marking of any kind. One of the larger phragmocones (Pl. 33, fig. 1) does appear to have broad, low, radial folds on the flanks. The suture is typical for the genus, and is illustrated on Figure 48E. It is somewhat like the suture of *U. sieveri* but has much coarser denticulation of the lobes; it differs from the suture of *U. mansfieldi* to a very marked degree.

Occurrence. Collection M111, 1,420 to 1,530 feet above the base, Thaynes Formation, Confusion Range, Utah, from section 15 of Hose and Repenning (1959).

Repository. Holotype, USNM 153085 (Pl. 33, fig. 1); paratypes USNM 153086 (Pl. 33, fig. 2), USNM 153087 (Pl. 33, figs. 3, 4), USNM 153088 (Pl. 33, figs. 5, 6); suture specimen USNM 153089 (Fig. 48E).

Ussurites mansfieldi n. sp.

Plate 44, figures 1–3; Plate 45, figures 1–3; Text-figure 48

The *Columbites* fauna of southeastern Idaho has yielded 10 specimens of this most interesting species. The available measurements of five of these specimens are listed in Table 52. There is one exceptionally large specimen, one of intermediate size, and the remaining forms of relatively small diameter. The largest specimen, and holotype, is preserved only on one side and the adoral one-half volution, which is body chamber, is crushed. The inner volutions are not crushed. These inner volutions have rounded lateral areas, rounded umbilical shoulders and a steep, rounded umbilical wall. The height of the whorl in relation to the width increases greatly during shell growth. On approximately the first two volutions, the whorl width and height are much the same; on later volutions the whorls increase rapidly in height whereas the width increases quite modestly. At all stages of growth the venter is broadly rounded.

The shell of the body chamber of the large holotype bears fine, slightly sinuous growth lines which are periodically bundled to give rise to faint broad ribs. On the inner volutions the shell bears faint strigations in addition to extremely fine growth lines.

The large paratype (Pl. 45, figs. 2, 3) is all phragmocone with much of the shell preserved. The widely spaced, low, broad radial ribs are more conspicuous on this specimen, as are the fine, sinuous growth lines.

The small specimens show the whorl width to approximate the whorl height. Likewise, the shell is smooth, except for extremely fine growth lines and strigations.

Probably the most distinguishing feature of this species is the suture (Figure 48F–I). There is a large denticulated first lateral lobe, a much smaller second lateral lobe and an auxiliary series on the umbilical shoulder and wall. The saddles, however, are unusual, especially the long asymmetrical second lateral saddle. Figure 48 compares four sutures taken from a whorl height of 12 mm (diameter of approximately 24 mm) to one taken from the paratype at a whorl height of 47 mm (diameter of approximately 110 mm). The distinctive character of the suture is already well established at a small diameter. It is interesting to note that on the late mature suture (Fig. 48F) a "degeneration" occurs, expressed in the wavy outline of the saddles and to some extent in the lobes.

The large, asymmetrical second lateral saddle sets this species apart from all other

species of *Ussurites*. In addition to the suture, the general shape and configuration of the conch is distinctive. The two other American species of *Ussurites*, *U. sieveri* and *U. hosei*, are quite different; however, here the age factor may be significant. *Ussurites mansfieldi* is from the *Columbites* Zone. Nearly all other Scythian species of *Ussurites* are from the next higher *Subcolumbites* Zone.

Occurrence. The holotype and paratype were collected by Mr. Gordon R. Stephenson in Webster Canyon, Freedom Quadrangle, southeast Idaho (Sec. 1, T. 8S, R. 45E and Sec. 6, T. 8S, R. 46E). The paratype was found in a black limestone concretion within a 42 foot dark shale and thin limestone bed 120 feet above the *Meekoceras* limestone. The holotype was not found in place, but in a concretion at the base of a cliff with the above mentioned concretions which yielded the paratype. In addition, the species is known from the *Columbites* fauna at Hot Springs, southeast Idaho, and along Draney Creek, Stewart Flat Quadrangle, southeast Idaho (USGS Locality M98).

Repository. Holotype and large paratype (Pl. 45, figs. 1–3) are in the Department of Geology, Washington State University, Pullman, Washington; figured paratypes MCZ 9513 (Pl. 44, figs. 2, 3) and MCZ 9515 (Pl. 44, fig. 1); unfigured paratypes from Hot Springs MCZ 9514; suture specimen (Fig. 48I) USNM 153090.

Genus *Leiophyllites* Diener, 1915

Type species, *Monophyllites suessi* Mojsisovics, 1882

Leiophyllites variabilis (Spath)

Plate 22, figures 5–10; Text-figures 49, 50

Monophyllites pitamaha,—Arthaber (non Diener) 1911: 234, pl. 20(4), figs. 9–11; C. Renz, 1928: 155.

Monophyllites (*Leiophyllites*) *pitamaha* Diener, 1915: 205.

Monophyllites (*Leiophyllites*) aff. *pitamaha*,—Renz and Renz, 1947: 61; Renz and Renz, 1948: 76, pl. 3, figs. 9–9a, pl. 4, figs. 7–7b.

Eophyllites variabilis Spath, 1934: 296, pl. 2, fig. 3, pl. 6, fig. 1, pl. 7, fig. 1.

Eophyllites variabilis var. *involuta* Spath, 1934: 296 (= Arthaber, 1911: pl. 20(4), fig. 9).

Eophyllites variabilis var. *evoluta* Spath, 1934: 296, pl. 4, fig. 1.

Monophyllites (*Leiophyllites*) *praeconfucii* Renz and Renz, 1947: 61, 77; Renz and Renz, 1948: 73, pl. 4, figs. 1–1b, 2–2a.

Monophyllites (*Leiophyllites*) *georgalasi* Renz and Renz, 1947: 61, 77; Renz and Renz, 1948: 74, pl. 4, figs. 3–3a.

Monophyllites (*Leiophyllites*) *palaeotriadicus* Renz and Renz, 1947: 61, 78; Renz and Renz, 1948: 75, pl. 4, figs. 4–4a.

Leiophyllites praematurus Kiparisova, 1958b: pl. 7, fig. 13, text-fig. 17b; Kiparisova, 1961: 134, pl. 28, figs. 5, 6, text-figs. 101, 102.

The lectotype of this species (Arthaber, 1911: pl. 20(4), fig. 11) is not preserved in the collection of the Paleontological Institute, Vienna; the two figured paralectotypes (Arthaber, 1911: pl. 20(4), figs. 9, 10; Pl. 22, figs. 5–10 of this report) are fortunately still preserved and available for study. These two paralectotypes plus one additional unfigured specimen (Pl. 22, figs. 7, 8) and the many topotypes in the British Museum (Natural History) are not well preserved and the larger of the paralectotypes (Pl. 22, figs. 5, 6) has been ground and polished.

The Chios fauna contains a fair number of specimens which belong to this species but which Renz and Renz (1948) placed in four distinct species. The differences between these species are mainly in whorl dimensions and expressions of fine ornamentation. The measurements of the Chios and Albania specimens considered to belong to this species are listed on Table 53 and plotted on the graph of Figure 50. These data do not suggest that the differences in whorl dimensions are anything more than what should be expected. It is, however, possible that some of the unfigured specimens in the Chios collection placed here (e.g. the more involute forms) are really species of *Eophyllites*. In regard

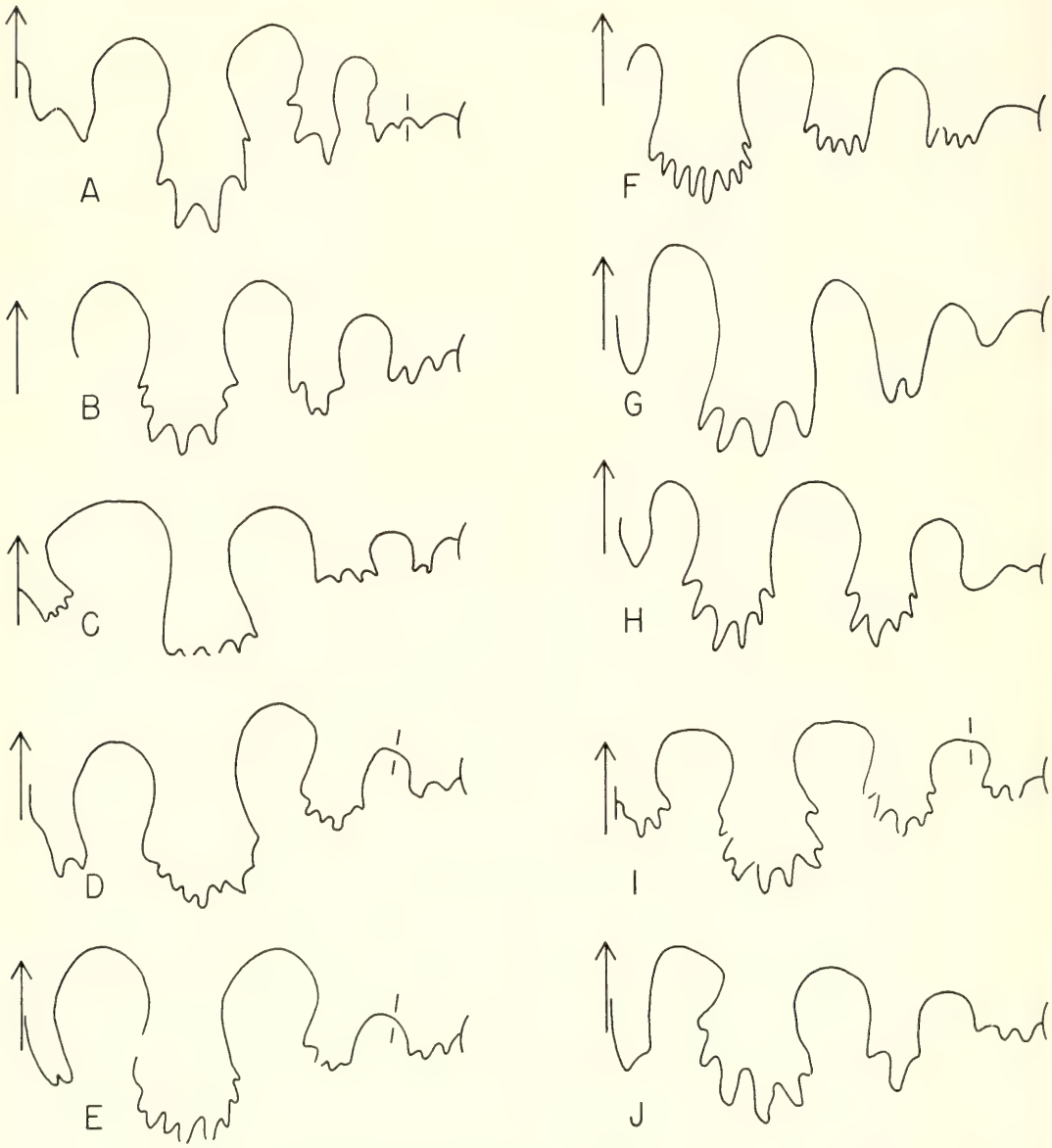

Figure 49. Diagrammatic representation of the suture of: A, paralectotype *Eophyllites variabilis* Spath (= *Monophyllites pitamaha* Arthaber [non Diener] 1911: pl. 20(4), fig. 10c; Pl. 22, figs. 5, 6 of this report), from *Subcolumbites* fauna of Albania at a diameter of 28 mm; B, paratype *Leiophyllites praematurus* Kiparisova (1961: 135, fig. 101), from *Subcolumbites* fauna, Primorye Region, Siberia; C, holotype *Leiophyllites radians* Astakhova (1960a: 146, fig. 12), from *Stacheites* Zone of Astakhova (1960a) Mangyshlak Peninsula; D, holotype *Danubites* (*Preflorianites*) *maritimus* Kiparisova (1961: 146, fig. 111), from *Subcolumbites* fauna of Primorye Region, Siberia, at a whorl height of 8 mm; E, holotype *Danubites* (*Preflorianites*) *inflatus* Kiparisova (1961: 145, fig. 110), from the *Subcolumbites* fauna of Primorye Region, Siberia, at a whorl height of 7 mm; F, holotype *Leiophyllites serpentinus* Chao (1959: 149, fig. 48a), from *Subcolumbites* fauna of Kwangsi, China, at a whorl height of 16 mm; G, holotype *Leiophyllites serpentinus* Chao (1959: 149, fig. 48c), from *Subcolumbites* fauna of Kwangsi, China, at a diameter of 23 mm; H, holotype *Leiophyllites oxynotus* Chao (1959: 150, fig. 48b), from *Subcolumbites* fauna of Kwangsi, China, at a whorl height of 10 mm; I, holotype *Danubites* (*Danubites*) *incertus* Kiparisova (1961: 143, fig. 108), from *Subcolumbites* fauna of the Primorye Region, Siberia, at a whorl height of 10 mm; J, holotype *Danubites* (*Danubites*) *admaris* Kiparisova (1961: 142, fig. 106), from *Subcolumbites* fauna of the Primorye Region, Siberia, at a whorl height of 7 mm.

to surface ornamentation, the differences noted by various authors are more a reflection of preservation than anything else. The sutures, likewise, in all these species have the same basic pattern with minor differences which I consider to be intraspecific. The suture of the paralectotype as reproduced by Arthaber (1911: pl. 20(4), fig. 10c) is idealized. The suture was exposed by grinding and a new drawing is reproduced here on Figure 49A.

Comparison with the other upper Scythian species of *Leiophyllites*, namely from the *Subcolumbites* fauna of Kwangsi, China, and *L. praematurus* from the *Subcolumbites* fauna of the Primorye Region, is difficult because of lack of information on these species. Chao (1959) described four species of *Leiophyllites* on the basis of seven specimens. These species were separated by minor morphological features that appear more understandable as reflections of the rather poor preservation. On the features of conch evolution and whorl shape and dimensions, this species cannot be separated from *L. variabilis* from Albania and Chios. However, the sutures of these Kwangsi specimens are simpler than the Albanian and Chios species (Fig. 49), and on this basis I believe they should be kept in a distinct species group.

A species which I believe to be conspecific with *L. variabilis* is *L. praematurus* Kiparisova (1958b). That author compared her species mainly with Middle Triassic species of *Leiophyllites*, merely noting the similarity of the conch to that of *L. variabilis*. In this regard she pointed to the lesser denticulation of the lobes as an important distinction. The suture pattern of *L. praematurus* as illustrated by Kiparisova falls well within the variations found within the Chios specimens of *L. variabilis* (Fig. 49).

Occurrence. *Subcolumbites* fauna of Albania, Chios, and Primorye Region.

Repository. The primary types are in the Paleontological Institute, University of Vienna; the lectotype (Arthaber, 1911: pl. 20(4), fig. 11) is apparently lost, but two figured paralectotypes (Arthaber, 1911: pl. 20(4), figs. 9, 10) and one unfigured paralectotype of Arthaber are preserved in that institution. A large collection of topotypes is in the British Museum of Natural His-

TABLE 53. MEASUREMENTS OF *LEIOPHYLLITES VARIABILIS* (SPATH) FROM THE *SUBCOLUMBITES* FAUNAS OF ALBANIA AND CHIOS.

	D	W	H	U	W/D	H/D	U/D
1.	96.2	20.6	33.8	37.2	21.4	35.1	38.7
2.	68.8	16.7	20.0	34.3	24.3	29.1	49.9
3.	60.7	17.4	20.2	26.4	28.7	33.3	43.5
4.	52.2	13.5	15.0	27.0	25.9	28.7	51.7
5.	41.0	9.8	11.2	27.8	23.9	27.3	67.8
6.	39.5	10.5?	12.0	19.2	26.6?	30.4	48.6
7.	38.4	12.3	11.3	19.0	32.0	29.4	49.5
8.	37.4	12.5?	12.0	17.6	33.4?	32.1	47.1
9.	35.2	9.1	13.1	13.8	25.9	37.2	39.2
10.	34.5	8.2	12.0	14.5	23.8	34.8	42.0
11.	33.7	6.7	10.0	15.5	19.9	29.7	46.0
12.	30.5	8.0	9.3	13.3	26.2	30.5	43.6
13.	28.0	7.4	10.4	11.0	26.4	37.1	39.3
14.	26.5	7.7	9.1	10.6	29.1	34.3	40.0
15.	24.6	6.0	9.3	9.5	24.4	37.8	38.6
16.	21.5	6.3?	6.8	9.8	29.3?	31.6	45.6
17.	21.0	6.3	7.5	7.3	30.0	35.7	34.8
18.	19.1	5.8	7.4	7.0	30.4	38.7	36.6
19.	19.0	4.4	5.8	8.5	23.2	30.5	44.7
20.	18.0	5.3	7.0	5.6	29.4	38.9	31.1
21.	17.3	5.2	6.6	5.8	30.1	38.2	33.5

1. Plesiotype, *Monophyllites* (*Leiophyllites*) aff. *pitamaha*,—Renz and Renz (1948: pl. 3, figs. 9–9a), NHMB J13752.
2. Holotype, *Monophyllites* (*Leiophyllites*) *praeconfucii* Renz and Renz (1948: pl. 4, figs. 1–1b), NHMB J13740.
3. Plesiotype, *Monophyllites* (*Leiophyllites*) aff. *pitamaha*,—Renz and Renz (1948: pl. 4, figs. 7–7b), NHMB J13753.
4, 5. Unfigured paratypes, *Monophyllites* (*Leiophyllites*) *praeconfucii* Renz and Renz from Maradovuno, NHMB J13742.
6. Paratype, *Monophyllites* (*Leiophyllites*) *praeconfucii* Renz and Renz (1948: pl. 4, fig. 2–2a), NHMB J13741.
7. Holotype, *Monophyllites* (*Leiophyllites*) *georgalasi* Renz and Renz (1948: pl. 4, figs. 3–3a), NHMB J13744.
8. Holotype, *Monophyllites* (*Leiophyllites*) *palaeotriadicus* Renz and Renz (1948: pl. 4, figs. 4–4a), NHMB J13749.
9–11, 13–15, 17–21. Unfigured specimens of *Monophyllites* (*Leiophyllites*) aff. *pitamaha* from Maradovuno, NHMB J13754.
12. Paralectotype, *Eophyllites variabilis* Spath (= *Monophyllites pitamaha* Arthaber (non Diener), 1911: pl. 20(4), figs. 10 a–c), PIUV.
16. Paralectotype, *Eophyllites variabilis* Spath (= *Monophyllites pitamaha* Arthaber (non Diener), 1911: p. 20(4), figs. 9a, b), PIUV.

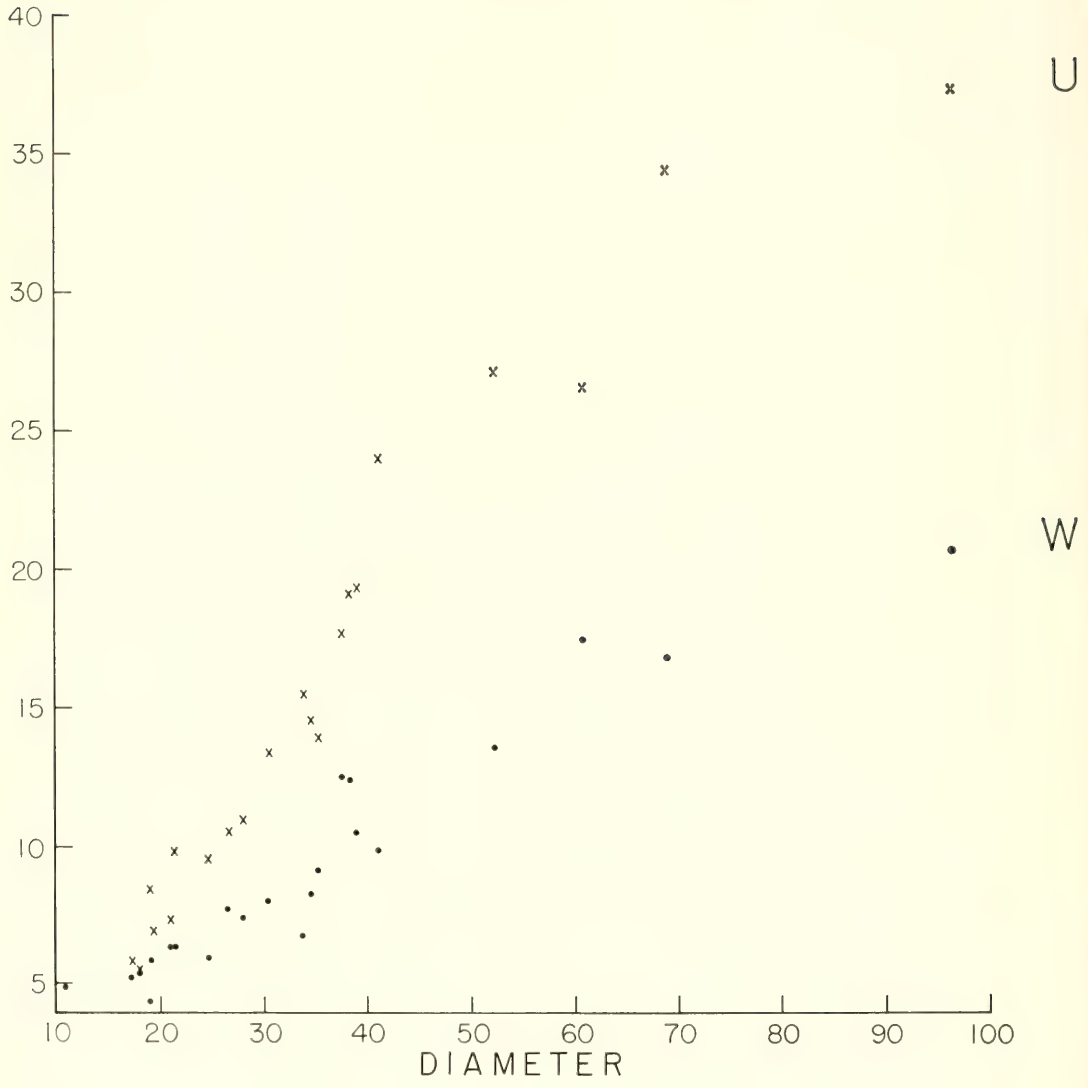

Figure 50. Variation in umbilical diameter (U) and whorl width (W) of *Leiophyllites variabilis* from *Subcolumbites* faunas of Albania and Chios. The data on this graph are from Table 53.

tory. The Natural History Museum, Basel, contains the following specimens from Chios studied by Renz and Renz (1948): plesiotype, *Monophyllites* (*Leiophyllites*) aff. *pitamaha* Renz and Renz (1948: pl. 3, fig. 9) NHMB J13752, (pl. 4, fig. 7) NHMB J13753; unfigured specimens from Maradovuno NHMB J13754, from Kephalovuno NHMB J13755; holotype, *Monophyllites (Leiophyllites) praeconfucii* Renz and Renz (1948: pl. 4, fig. 1) NHMB J13740; paratype (pl. 4, fig. 2) NHMB J13741; unfigured paratypes from Maradovuno NHMB J13742, from Kephalovuno NHMB J13743; holotype, *Monophyllites* (*Leiophyllites*) *georgalasi* Renz and Renz (1948: pl. 4, fig. 3) NHMB J13744; unfigured paratypes NHMB J13745; holotype,

Monophyllites (*Leiophyllites*) *palaeotriadicus* Renz and Renz (1948: pl. 4, fig. 4) NHMB J13749; unfigured paratypes from Maradovuno NHMB J13750, from Kephalovuno NHMB J13751.

Leiophyllites radians Astakhova
Text-figure 49

Leiophyllites radians Astakhova, 1960a: 146, pl. 34, fig. 10, text-fig. 12.

This species has the general leiophyllitid conch form but is characterized by broadly spaced, low radial ribs that cross the venter. Adorally the ribs tend to decrease in size and eventually disappear. The suture is shown on Figure 49C. Assuming that it is accurately drawn, it is a much simpler suture than that of most other species of this genus. The only other species of *Leiophyllites* that have ornamentation consisting of ribs are the two species from the Primorye Region (*L. maritimus* and *L. admaris*). However, these two species have quite different ribbing patterns and very different sutures (Fig. 49).

Occurrence. *Stacheites* Zone of Astakhova (1960a) Mangyshlak Peninsula.

Leiophyllites serpentinus Chao
Text-figure 49

Leiophyllites serpentinus Chao, 1959: 149, 331, pl. 42, figs. 7, 13–15, text-fig. 48a.
Leiophyllites oxynotus Chao, 1959: 150, 332, pl. 42, figs. 11, 12, text-fig. 48b.
Leiophyllites lolouensis Chao, 1959: 150, 332, pl. 42, figs. 8–10, text-fig. 48c.
Leiophyllites aff. *pitamaha* Chao, 1959: 150, 332, pl. 42, fig. 1.
Leiophyllites kwangsiensis Chao, 1959: 7, 160, (*nomen nudum*).
Leiophyllites vermiformis Chao, 1959: 7, 160 (*nomen nudum*).

All the species listed above in the synonymy are based on one or very few specimens of only fair preservation, and all came from the same horizon and locality. Chao describes the venter on some of his species as fastigate but this is not apparent on the illustration of the species. On the basis of the data available, all these species have the general conch architecture of *L. variabilis* and are considered to be conspecific. They differ from *L. variabilis* in the suture (Fig. 49).

Occurrence. Limestone block (Chao collection 542b) Kwangsi, China.

Leiophyllites admaris (Kiparisova)
Text-figure 49

Danubites (*Danubites*) *admaris* Kiparisova, 1961: 142, pl. 28, fig. 11, text-fig. 106.
Danubites (*Danubites*) aff. *floriani* Mojsisovics,— Kiparisova, 1961: 141, pl. 28, fig. 10, text-fig. 105.
Danubites (*Danubites*?) *incertus* Kiparisova, 1961: 143, pl. 29, figs. 1, 2, text-figs. 107, 108.

The assignment of these species and *maritimus* to *Leiophyllites* is done entirely on the basis of the suture pattern (Fig. 49). The ornamentation of these species and especially that of *maritimus* would ally these species to *Preflorianites*. In the interpretation followed here the suture is considered the more critical sign post of genetic affinity and the ornamentation a case of homeomorphy. The different species brought together here differ mainly in the degree of ribbing.

Occurrence. *Subcolumbites* fauna, Primorye Region, Siberia.

Leiophyllites maritimus (Kiparisova)
Text-figure 49

Preflorianites maritimus Kiparisova, 1958b: pl. 8, fig. 3, text-fig. 22b.
Danubites (*Preflorianites*) *maritimus* Kiparisova, 1961: 146, pl. 29, figs. 8, 9, text-fig. 111.
Danubites (*Preflorianites*) *inflatus* Kiparisova, 1961: 145, pl. 29, figs. 3, 4, text-figs. 109–110.
Danubites (*Preflorianites*) aff. *maritimus* Kiparisova, 1961: 147, pl. 29, fig. 10, text-fig. 112.

This species has a suture (Fig. 49D) much like that of *L. admaris* but the rib pattern is completely preflorianitid in aspect, that is, concentrated near the umbilical shoulder. The specimen from an upper Scythian horizon in the Toad Formation of British Columbia that Tozer (1965a: 40) assigned to *Leiophyllites* sp. indet. is quite similar to *L. maritimus*.

Occurrence. *Subcolumbites* fauna, Primorye Region, Siberia.

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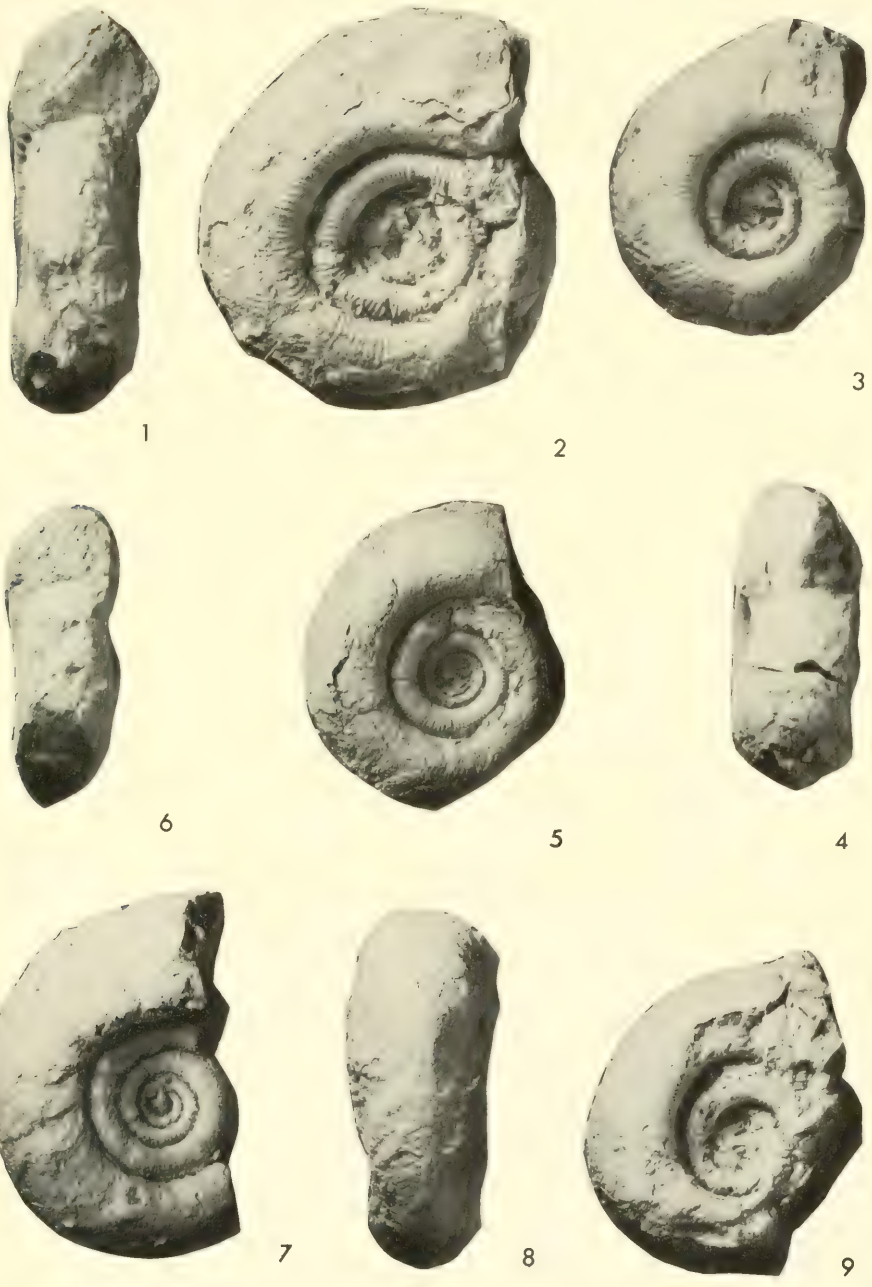
All specimens are from the *Subcolumbites* fauna of Kčira, Albania, and are deposited in the Paleontological Institute, Vienna.



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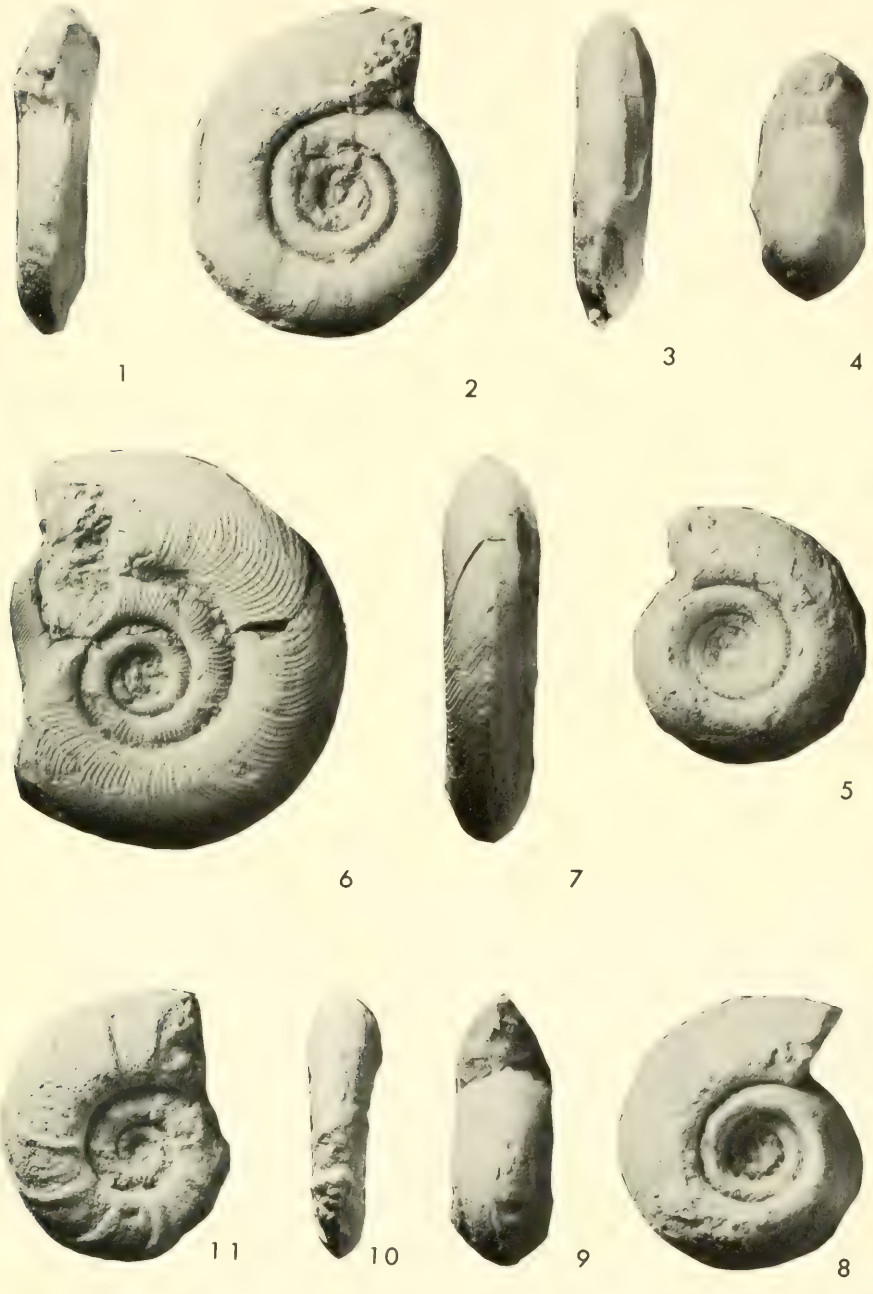
	All specimens are from the *Subcolumbites* fauna of Kčira, Albania, and are deposited in the Paleontological Institute, Vienna.	



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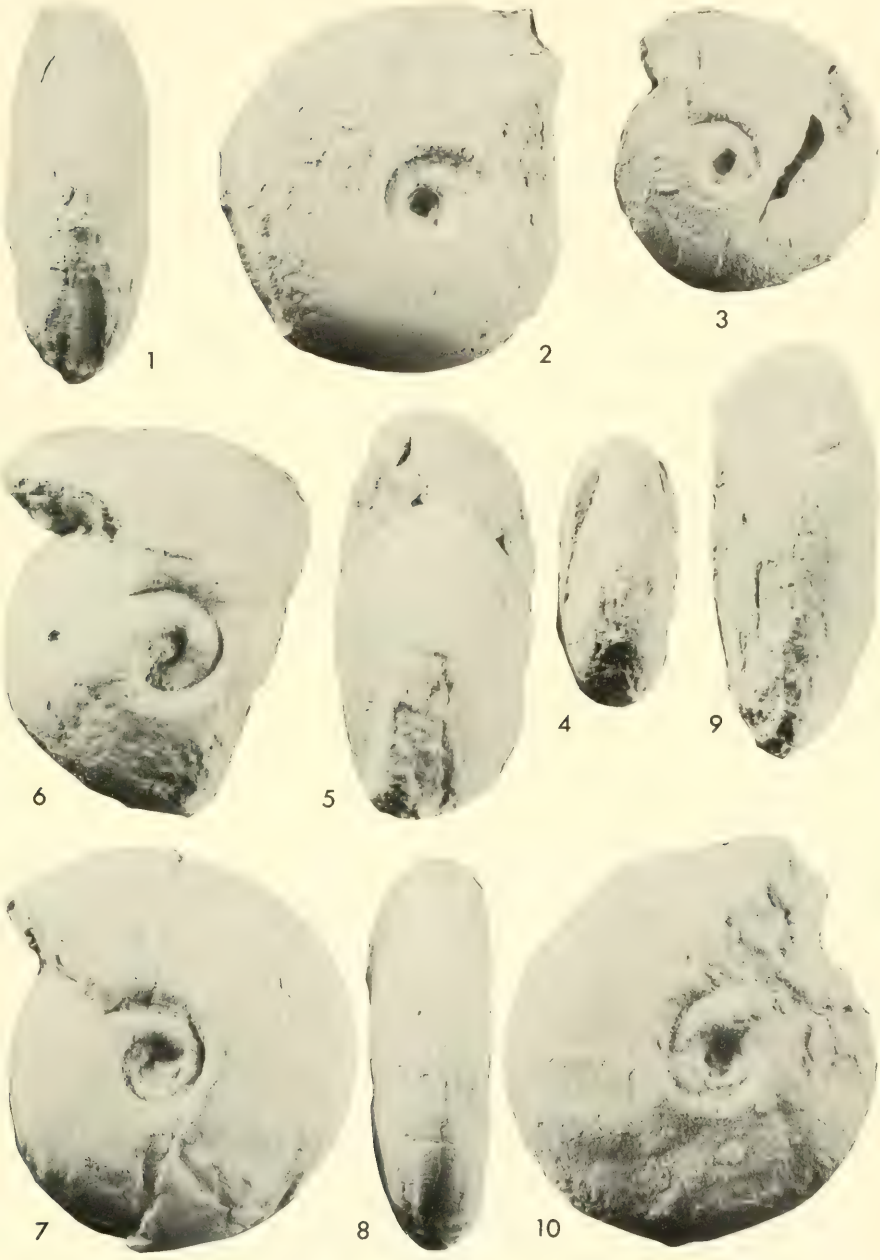

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All specimens are from the *Subcolumbites* fauna of Kčira, Albania, and are deposited in the Paleontological Institute, Vienna.

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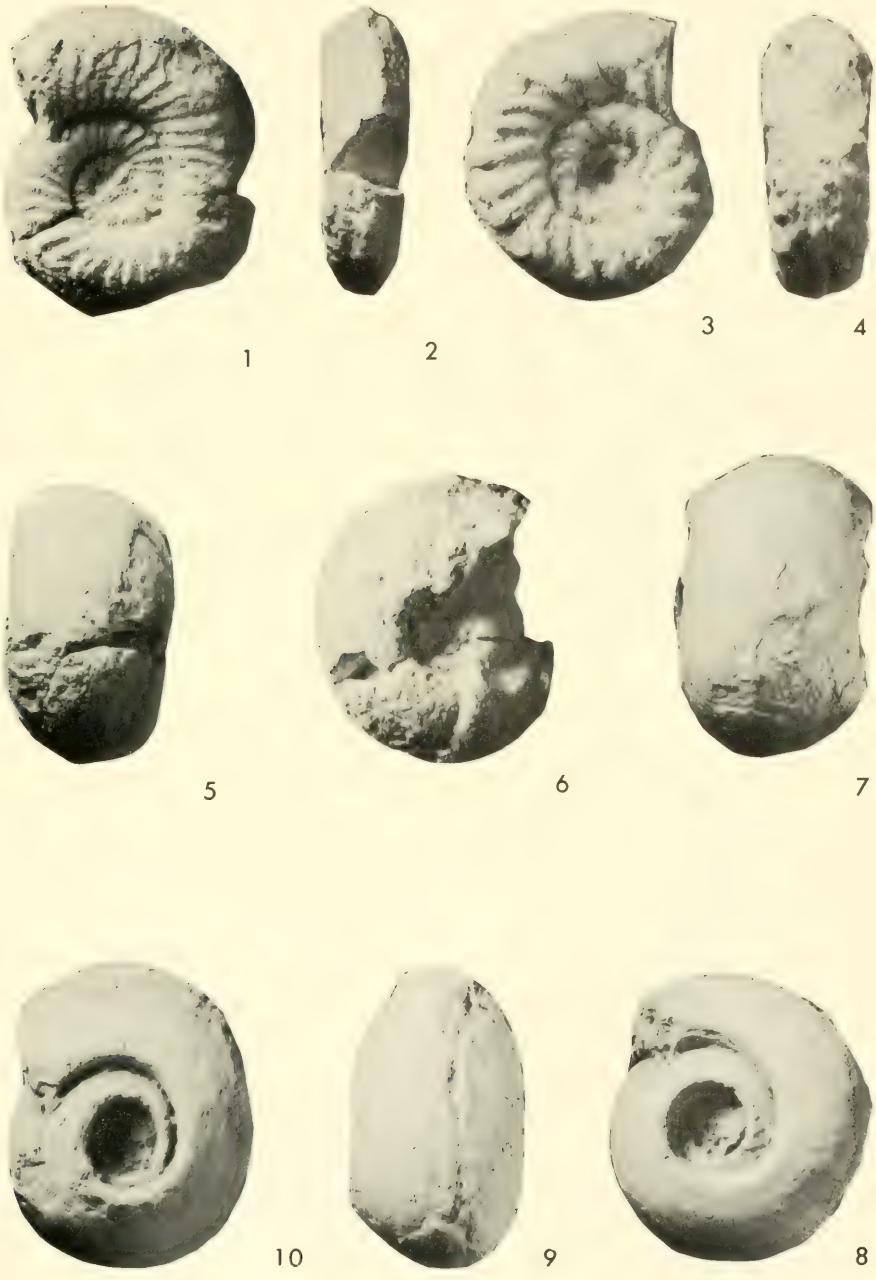
All specimens are from the *Subcolumbites* fauna of Kčira, Albania, and are deposited in the Paleontological Institute, Vienna.



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Both specimens are from the *Subcolumbites* fauna of Kčira, Albania, and are deposited in the Paleontological Institute, Vienna.

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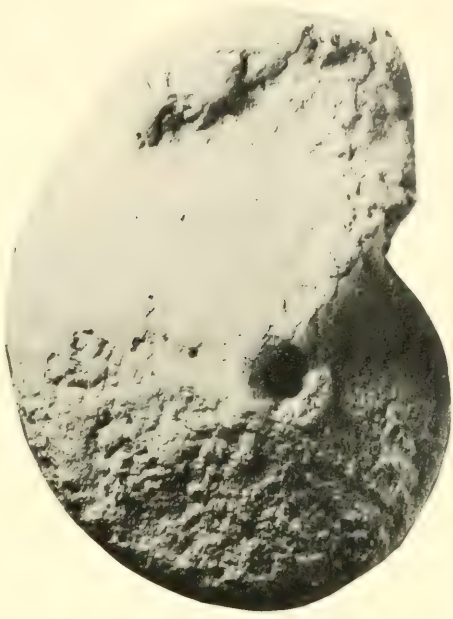

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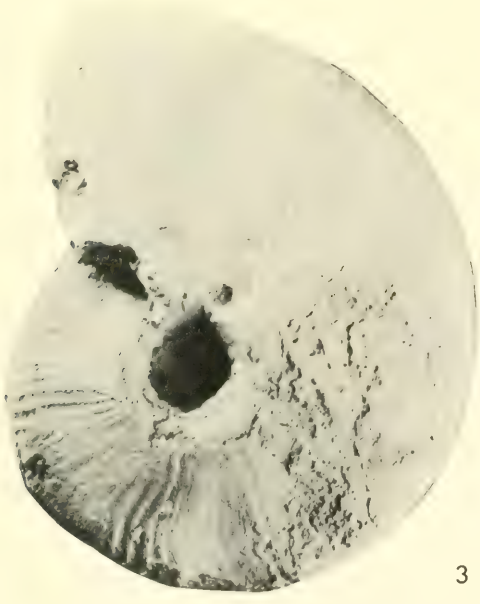

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Plate 8

PLATE 9. PROPTYCHITOIDES TRIGONALIS

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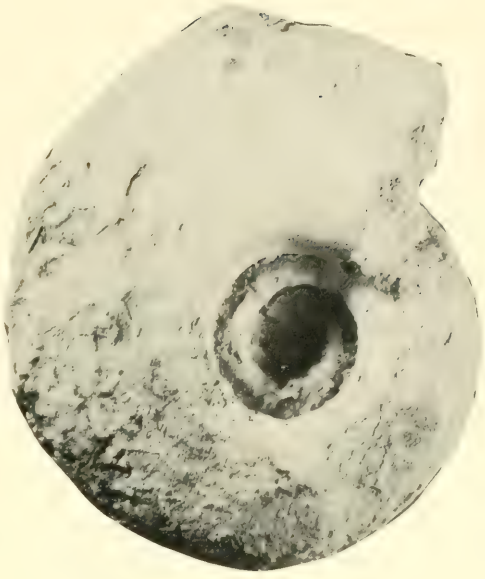
1–4 *Proptychitoides trigonalis* (Arthaber) 388

Figs. 1, 2, ventral and side view of holotype of *Proptychites bertisci* Arthaber (1911: pl. 19(3), figs. 5a–c), × 1. Figs. 3, 4, ventral and side view of holotype of *Proptychites trigonalis* Arthaber (1911: pl. 19(3), figs. 4a–c), × 1.

Both specimens are from the *Subcolumbites* fauna of Kčira, Albania, and are deposited in the Paleontological Institute, Vienna.



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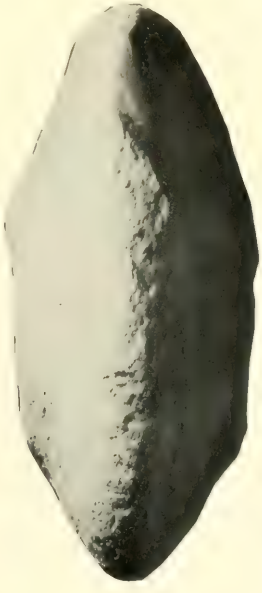

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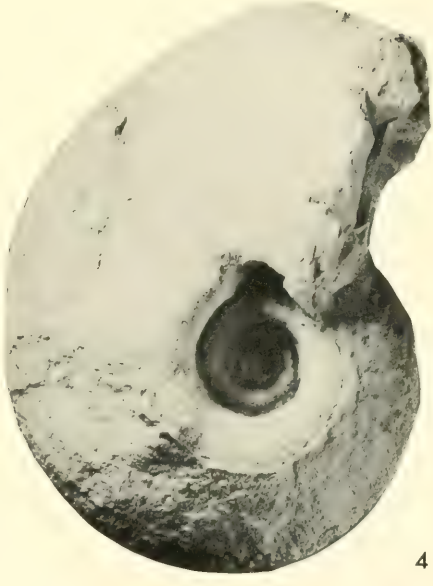

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Plate 9

PLATE 10. PROPTYCHITOIDES TRIGONALIS

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1–4 *Proptychitoides trigonalis* (Arthaber) 388

Figs. 1, 2, ventral and side view of holotype of *Meekoceras mahomedis* Arthaber (1911: pl. 22(6), figs. 3a–c), × 1. Figs. 3, 4, right and left side views of *Proptychitoides* (?) *nopcsai* Spath (=*Proptychites obliqueplicatus*,–Arthaber [non Waagen], 1911: pl. 20(4), figs. 1a–c), × 1.

Both specimens are from the *Subcolumbites* fauna of Kčira, Albania, and are deposited in the Paleontological Institute, Vienna.

Plate 10

PLATE 11. PROCARNITES and PROPTYCHITOIDES

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1–4 *Procarnites kokeni* (Arthaber) — 391

Figs. 1, 2, side and ventral view of lectotype of *Procarnites skanderbegis* Arthaber (1911: pl. 18(2), figs. 7a–c), × 1. Figs. 3, 4, side and ventral view of paralectotype of *Procarnites skanderbegis* Arthaber (1911: pl. 18(2), figs. 6a–c), × 1.

5 *Proptychitoides trigonalis* (Arthaber) — 388

Ventral view of specimen shown on Pl. 10, figs. 3, 4, × 1.

All specimens are from the *Subcolumbites* fauna of Kčira, Albania, and are deposited in the Paleontological Institute, Vienna.

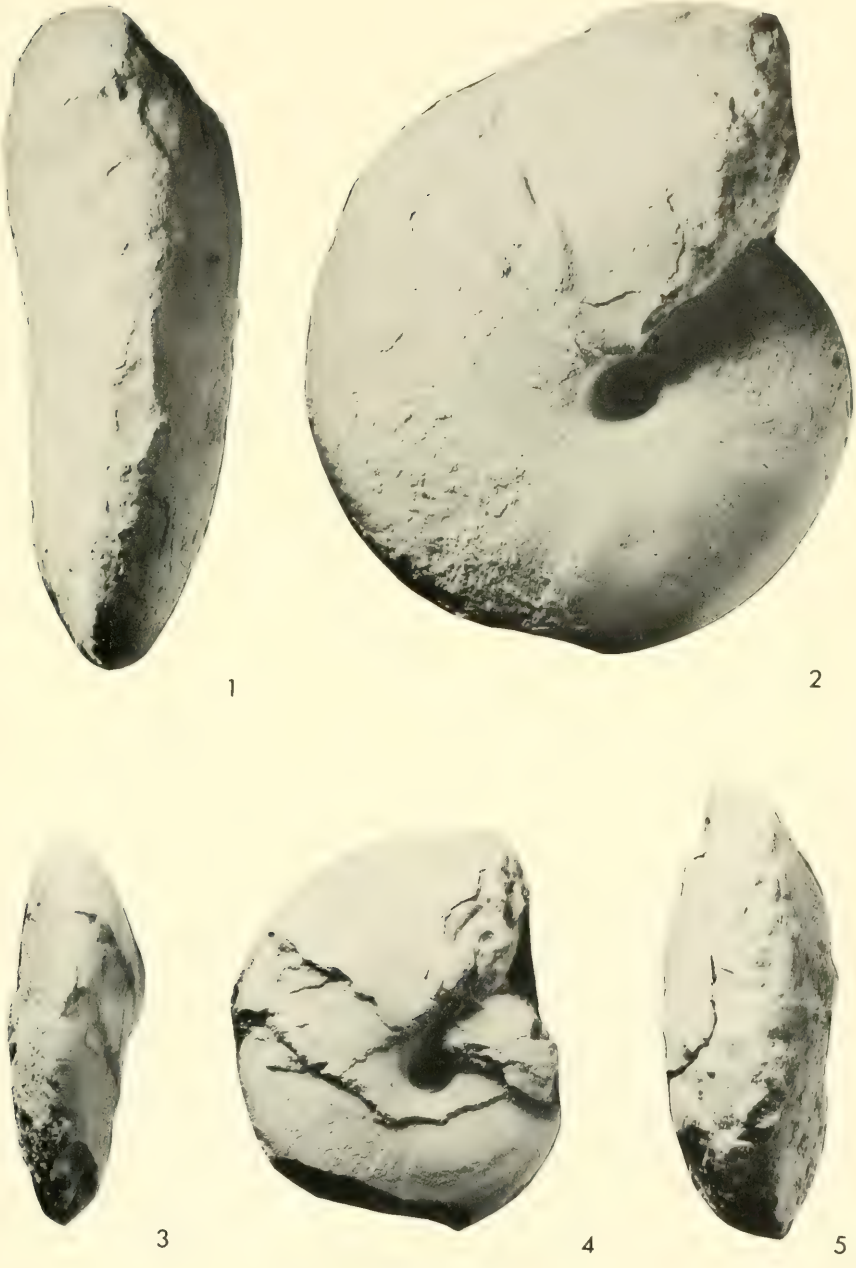

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PLATE 12. PROCARNITES, PROPTYCHITOIDES, and PSEUDOSAGECERAS

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1, 2 *Procarnites kokeni* (Arthaber) — 391
Side and ventral view of topotype (Arthaber, 1911: pl. 18(2), figs. 5a, b), × 0.7.

3 *Proptychitoides decipiens* Spath — 385
Side view of holotype of *Meekoceras hakki* Arthaber (1911: pl. 22(6), figs. 1a–c), × 0.5.

4, 5 *Pseudosageceras drinense* Arthaber — 363
Side and ventral view of holotype, Arthaber (1911: pl. 17(1), figs. 6a, b), × 1.
All specimens are from the *Subcolumbites* fauna of Kčira, Albania, and are deposited in the Paleontological Institute, Vienna.

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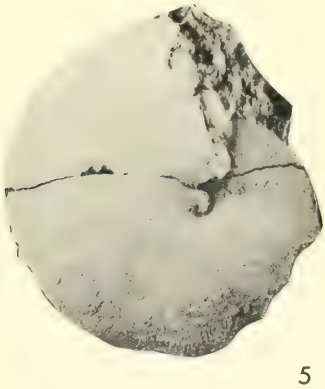

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Plate 12

PLATE 13. PROCARNITES KOKENI

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1–8 *Procarnites kokeni* (Arthaber) 391

Figs. 1, 2, side and ventral view of lectotype (Arthaber, 1908: pl. 11(1), figs. 1a–c), × 2. Figs. 3, 4, side and ventral view of paralectotype (Arthaber, 1908: pl. 11(1), figs. 2a, b), × 2. Figs. 5, 6, side and ventral view of plesiotype (Arthaber, 1911: pl. 17(1), figs. 17a–c), × 1. Figs. 7, 8, side and ventral view of plesiotype (Arthaber, 1911: pl. 17(1), figs. 16a, b), × 1.5.

All specimens are from the *Subcolumbites* fauna of Kčira, Albania, and are deposited in the Paleontological Institute, Vienna.

Plate 13

PLATE 14. PROTROPITES and METAHEDENSTROEMIA

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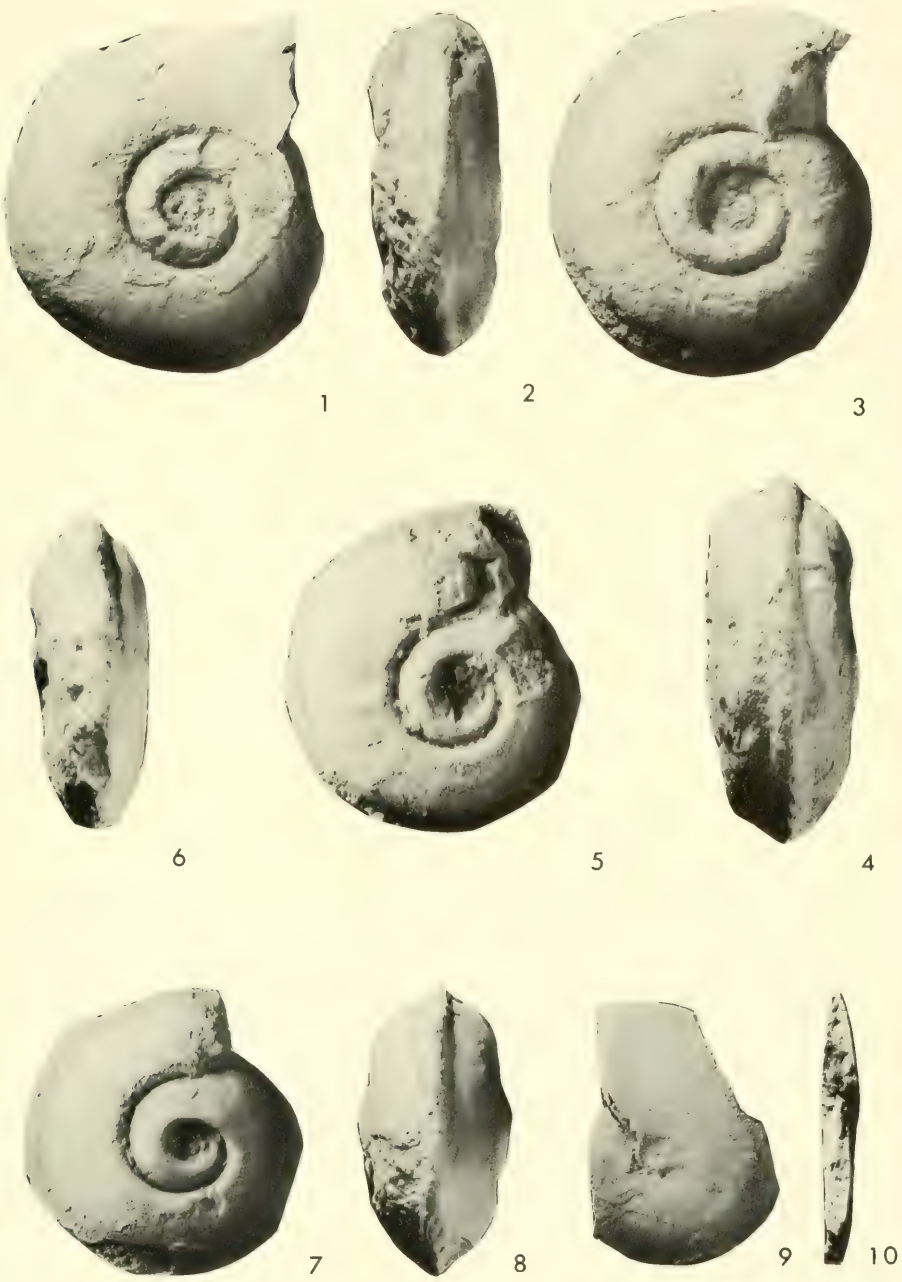
1–8 *Protropites hilmi* Arthaber — 445

Figs. 1, 2, ventral and side view of paralectotype, Arthaber (1911: pl. 22(6), figs. 13a, b), × 1.5. Figs. 3, 4, ventral and side view of lectotype, Arthaber (1911: pl. 22(6), figs. 15a, b), × 1.5. Figs. 5, 6, ventral and side view of paralectotype, Arthaber (1911: pl. 22(6), figs. 12a, b), × 1.5. Figs. 7, 8, ventral and side view of paralectotype, Arthaber (1911: pl. 22(6), figs, 14a, b), × 1.5.

9, 10 *Metahedenstroemia kastriotae* (Arthaber) — 449

Side and front view of holotype (Arthaber, 1911: pl. 17(1), figs. 14a–c), × 1.

All specimens are from the *Subcolumbites* fauna of Kčira, Albania, and are deposited in the Paleontological Institute, Vienna.



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1, 2 *Dagnoceras nopcsanum* Arthaber — 459
Ventral and side view of holotype, Arthaber (1911: pl. 21(5), figs. 6a–c), × 1.5.

3–11 *Dagnoceras zappanense* Arthaber — 459
Figs. 3, 4, ventral and side view of paralectotype, Arthaber (1911: pl. 21(5), figs. 8a, b), × 1. Figs. 5, 6, ventral and side view of lectotype, Arthaber (1911: pl. 21(5), figs. 9a, b), × 1. Figs. 7, 8, ventral and side view of lectotype of *Dagnoceras lejanum* Arthaber (1911: pl. 21(5), figs. 13a–c), × 1. Figs. 9–11, ventral and side views of paralectotype of *Dagnoceras lejanum* Arthaber (1911: pl. 21(5), figs. 12a, b), × 1.5.
All specimens are from the *Subcolumbites* fauna of Kčira, Albania, and are deposited in the Paleontological Institute, Vienna.

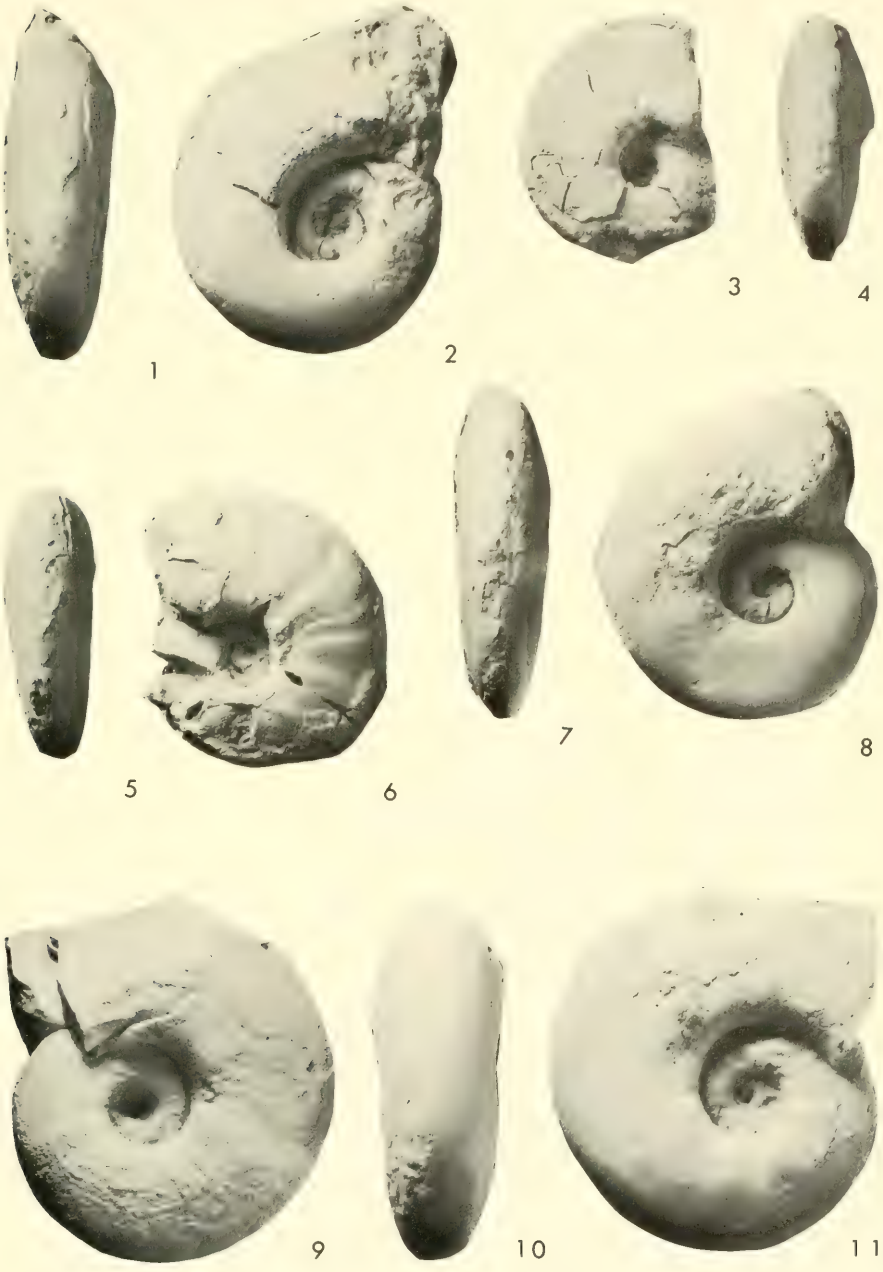

Plate 15

PLATE 16. DAGNOCERAS, METADAGNOCERAS, and "ASPIDITES"

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1, 2	*Dagnoceras nopcsanum* Arthaber Side and ventral view of variety of Arthaber (1911: pl. 21(5), figs. 7a–c), × 1.5.	459
3–6	*Albanites triadicus* (Arthaber) Figs. 3, 4, side and ventral view of lectotype of *Aspidites hasserti* Arthaber (1911: pl. 21(5), figs. 16 a–c), × 1. Figs. 5, 6, side and ventral view of paralectotype of *Aspidites hasserti* Arthaber (1911: 249), × 2.	477
7, 8	*Metadagnoceras terbunicum* (Arthaber) Ventral and side view of lectotype of *Dagnoceras terbunicum* Arthaber (1911: pl. 21(5), figs. 10a–c), × 1.	463
9, 10	*"Aspidites" marginalis* Arthaber Ventral and side view of holotype, Arthaber (1908: pl. 11(1), figs. 6a–c), × 2.	339

All specimens are from the *Subcolumbites* fauna of Kčira, Albania, and are deposited in the Paleontological Institute, Vienna.

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PLATE 17. ALBANITES TRIADICUS

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1–10 *Albanites triadicus* (Arthaber) 477

Figs. 1, 2, side and ventral view of paralectotype of *Pronorites arbanus* Arthaber (1911: pl. 17(1), figs. 12a, b), × 1. Figs. 3, 4, unfigured specimen of Arthaber (1911), × 2. Figs. 5, 6, side and ventral view of lectotype of *Pronorites osmanicus* Arthaber (1911: pl. 17(1), figs. 10a–c), × 1. Figs. 7, 8, side and ventral view of holotype of *Pronorites triadicus* Arthaber (1908: pl. 11(1), figs. 4a, c; 1911: pl. 17(1), figs. 8, 9), × 1.5. Figs. 9, 10, side and ventral view of lectotype of *Pronorites arbanus* Arthaber (1911: pl. 17(1), figs. 11 a–c), × 1.5.

All specimens are from the *Subcolumbites* fauna of Kčira, Albania, and are deposited in the Paleontological Institute, Vienna.

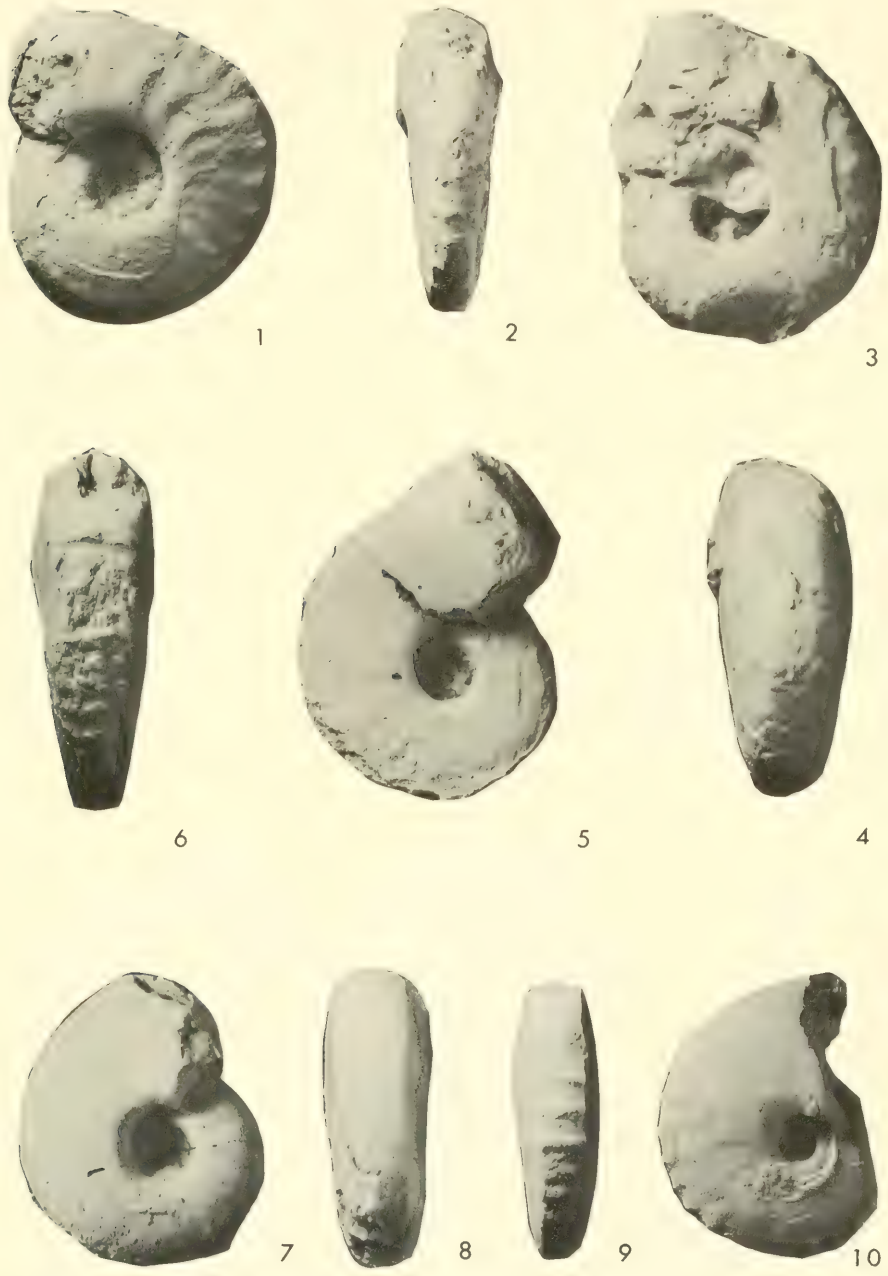

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PLATE 18. TIROLITES, ALBANITES, and METADAGNOCERAS

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1–6 *Tirolites idrianus* (Hauer) — 492

Figs. 1, 2, side and ventral view of *Tirolites rectangularis*,–Arthaber (1911: pl. 22(6), figs. 5a, b), × 1. Figs. 3, 4, side and ventral view of *Tirolites illyricus*,–Arthaber (1911: pl. 22(6), figs. 4a, b), × 1.5. Figs. 5, 6, side and ventral view of *Tirolites seminudus*,–Arthaber (1908: pl. 11(1), figs. 9a–c), × 1.5.

7, 8 *Albanites triadicus* (Arthaber) — 477

Side and ventral view of holotype of *Dagnoceras komanum* Arthaber (1911: pl. 21(5), figs. 11a–c), × 2.

9, 10 *Metadagnoceras terbunicum* (Arthaber) — 463

Side and ventral view of *Meekoceras radiosum*,–Arthaber (1911: pl. 21(5), figs. 14a–c), × 1.

All specimens are from the *Subcolumbites* fauna of Kčira, Albania, and are deposited in the Paleontological Institute, Vienna.

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1, 2 *Preflorianites sulioticus* (Arthaber) — 379
Side and ventral view of *Ophiceras* cf. *nangaensis*,–Arthaber (1911: pl. 21(5), figs. 5a, b), × 1.5.

3, 4 *Dieneroceras mediterranea* (Arthaber) — 367
Side and ventral view of *Ophiceras sakuntala*,–Arthaber (non Diener) (1911: pl. 21(5), figs. 4a, b), × 1.

5–8 *Preflorianites sulioticus* (Arthaber) — 379
Figs. 5, 6, syntype (Arthaber, 1911: pl. 20(4), figs. 2a, b), × 1.5. Figs. 7, 8, syntype (Arthaber, 1911: pl. 19(3), figs. 6a, b), × 1.

9, 10 *"Lecanites" niazi* Arthaber — 338
Side and ventral view of holotype, *Lecanites niazi* Arthaber (1911: pl. 21(5), figs. 3a–c), × 2.
All specimens are from the *Subcolumbites* fauna of Kčira, Albania, and are deposited in the Paleontological Institute, Vienna.

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PLATE 20. TUNGLANITES, DIENEROCERAS, CORDILLERITES, ALBANITES, PREFLORIANITES, PROSPHINGITES, and MEROPELLA

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1, 2	*Tunglanites alexi* n. sp. Side and ventral view of holotype (=*Styrites lilangensis*,–Arthaber (non Diener) (1911: pl. 23(7), fig. 12), × 1.5.	423
3, 4	*Dieneroceras skutarensis* (Arthaber) Side and ventral view of holotype of *Lecanites skutarensis* Arthaber (1911: pl. 21(5), fig. 1), × 1.5.	368
5, 6	*Cordillerites angulatus* Hyatt and Smith Side and ventral view of holotype of *Hedenstroemia skipetarensis* Arthaber (1911: pl. 17(1), fig. 13); Fig. 5, × 2, Fig. 6, × 2.5.	364
7, 8, 9	*Albanites triadicus* (Arthaber) Side and ventral views of *Pseudosibirites* cfr. *dichotomus*,–Arthaber (1911: pl. 22(6), fig. 8), × 1.5.	477
10, 11	*Preflorianites garbinus* (Renz and Renz) Side and ventral view of *Inyoites garbinus* Renz and Renz (1948). NHMB 13697, × 1.5.	381
12, 13	*Prosphingites ali* Arthaber Side and ventral view of holotype, Arthaber (1911: pl. 22(6), fig. 6), × 2.	405
14, 15	*Meropella plejanae* Renz and Renz Side and ventral view of paratype, NHMB J19550, × 2.	477

Specimens of Figures 1–9, 12, 13 are from the *Subcolumbites* fauna of Albania and are deposited in the Paleontological Institute, Vienna; specimens of Figures 10, 11, 14, 15 are from the *Subcolumbites* fauna of Chios and are deposited in the Natural History Museum, Basel.

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PLATE 21. EOGYMNITES, BEATITES, and PSEUDOSAGECERAS

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1, 2 *Eogymnites arthaberi* (Diener) — 517
Side and ventral view of holotype,–Arthaber (1911: pl. 20(4), fig. 4), × 1.

3, 4 *Beatites berthae* Arthaber — 449
Side and ventral view of holotype, Arthaber (1911: pl. 17(1), fig. 15), × 1.5.

5, 6 *Pseudosageceras albanicum* (Arthaber) — 363
Side and front view of holotype (Arthaber, 1908: pl. 13(3), figs. 1a, b; 1911: pl. 17(1), figs. 4, 5), × 1.

All specimens are from the *Subcolumbites* fauna of Kčira, Albania, and are deposited in the Paleontological Institute, Vienna.

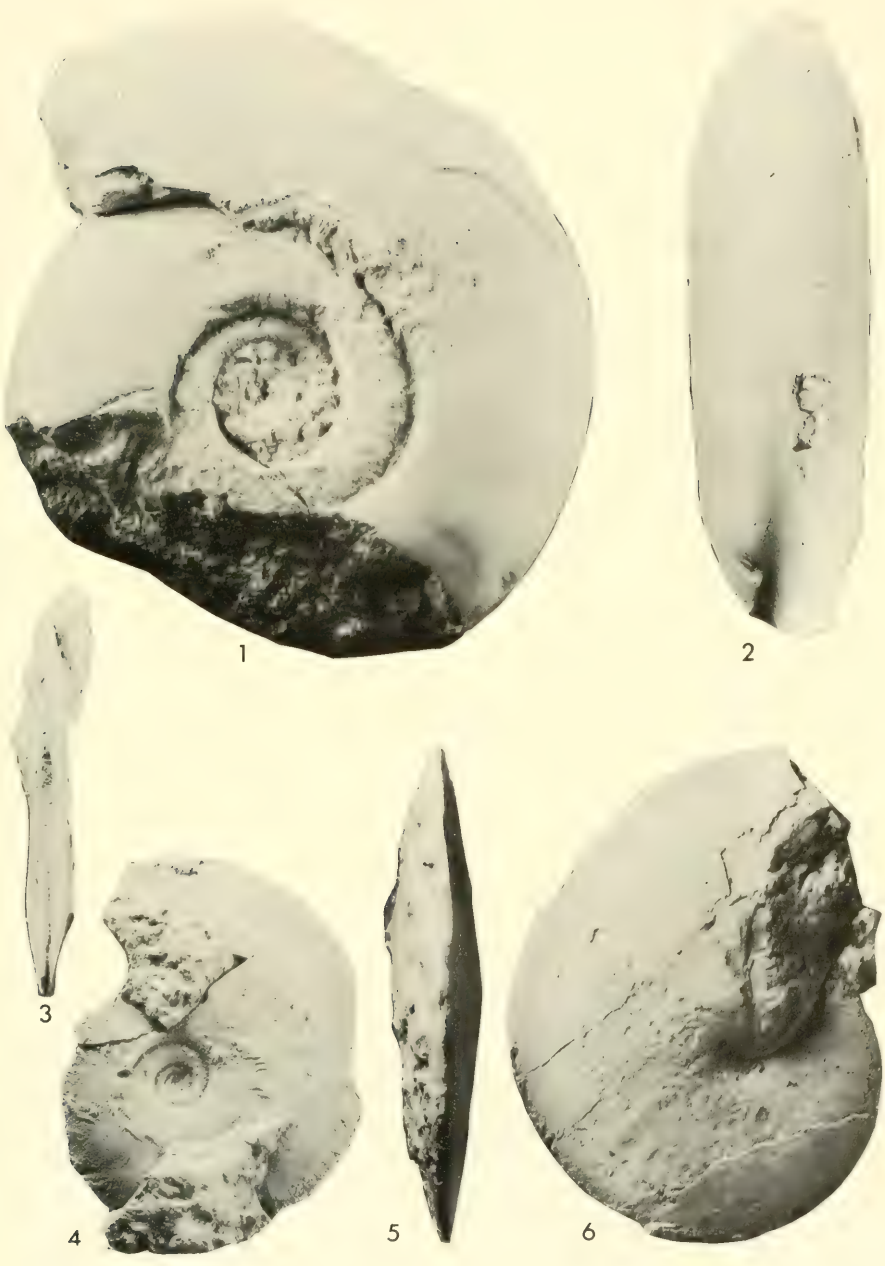

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PLATE 22. EOPHYLLITES and LEIOPHYLLITES

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1–4 *Eophyllites dieneri* (Arthaber) 524

Figs. 1, 2, side and ventral view of holotype of *Monophyllites nopcsai* Arthaber (1908: pl. 12(2), figs. 5a–c), × 1.5. Figs. 3, 4, side and ventral view of holotype of *Eophyllites refractus* Spath (= *Monophyllites hara*,–Arthaber [non Diener], 1908: pl. 12(2), figs. 4a–c), × 2.

5–10 *Leiophyllites variabilis* (Spath) (= *Monophyllites pitamaha*,–Arthaber [non Diener]) 531

Figs. 5, 6, paralectotype,–Arthaber (1911: pl. 20(4), figs. 10a–c), × 1.5. Figs. 7, 8, unfigured specimen,–Arthaber (1911: 234), × 1.5. Figs. 9, 10, paralectotype,–Arthaber (1911: pl. 20(4), figs. 9a, b), × 2.

All specimens are from the *Subcolumbites* fauna of Kčira, Albania, and are deposited in the Paleontological Institute, Vienna.

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PLATE 23. EOPHYLLITES

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1–7 *Eophyllites dieneri* (Arthaber) 524

Fig. 1, suture specimen of *Monophyllites dieneri* Arthaber (1911: pl. 20(4), fig. 8), × 1. Figs. 2, 3, syntype, Arthaber (1911: pl. 20(4), figs. 5a–c), × 1. Figs. 4, 5, unfigured specimen of Arthaber, × 1. Figs. 6, 7, side and front view of *Ussurites* (?) *decipiens* Spath (= *Monophyllites kingi*,–Arthaber [non Diener], 1911: pl. 20(4), figs. 12a–c), × 1.

All specimens are from the *Subcolumbites* fauna of Kčira, Albania, and are deposited in the Paleontological Institute, Vienna.

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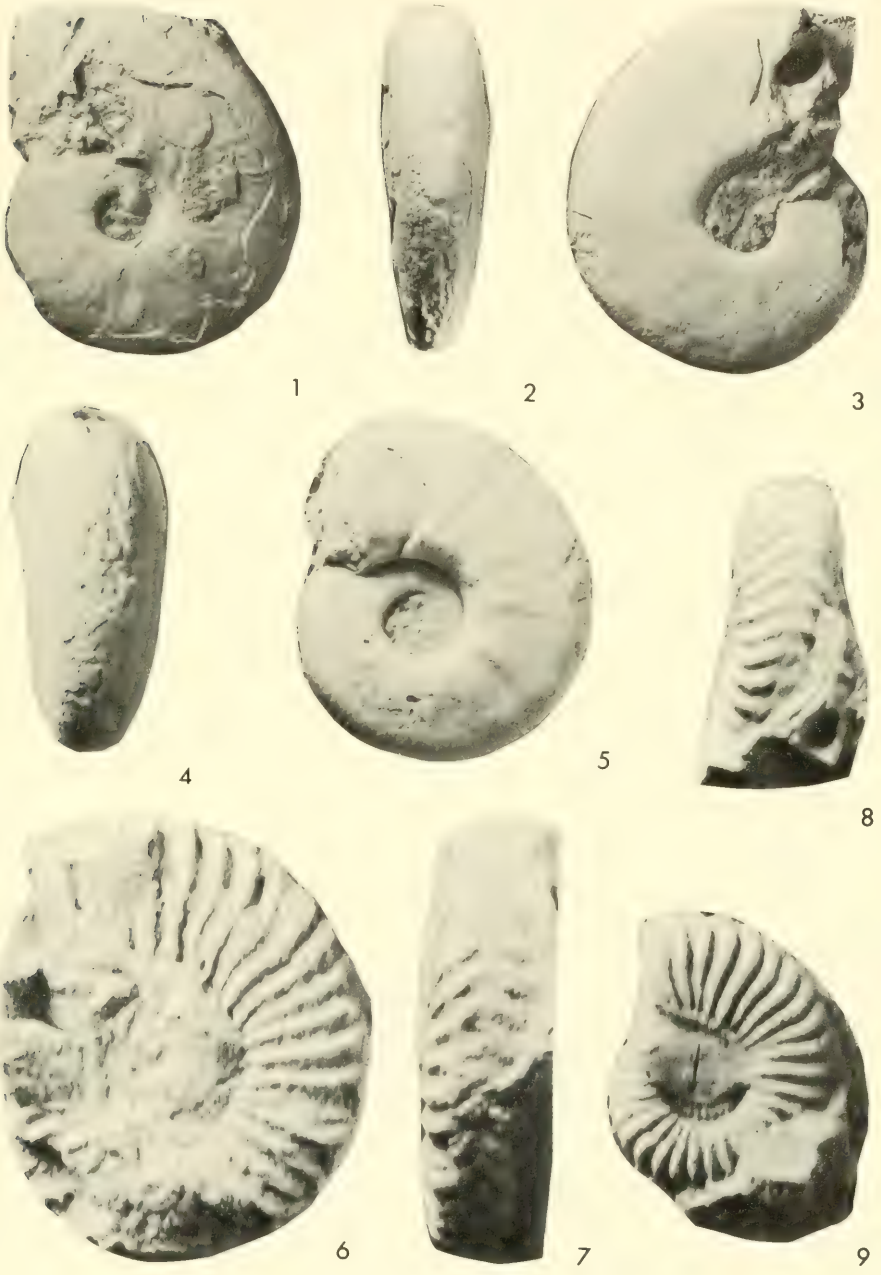
1–3	*Metadagnoceras freemani* n. sp. Right and left side and ventral view of holotype, BMNH C33701. From Nifoekoko, Timor, × 1.	463
4, 5	*Dagnoceras zappanense* Arthaber Side and ventral view of specimen from Nifoekoko, Timor. BMNH C33713, × 2.	459
6–9	*Sibirites renzi* n. sp. Side and ventral view of two paratypes, Figs. 6, 7, NHMB J19551, × 5; Figs. 8, 9 NHMB J19552, × 5 from Maradovuno, Chios.	483



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1, 2	*Proptychitoides arthaberi* (Welter) Ventral and side view of manganese coated specimen, presumably same age as fauna from block E at Nifoekoko, Timor, × 1.	390
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5	*Svalbardiceras schmidti* (Mojsisovics) Side view of *Meekoceras* sp. indet. Frebold (1929b: pl. 1, fig. 11), × 1.	451
6, 7	*Keyserlingites subrobustus* (Mojsisovics) Fig. 6, side view of specimen figured by Frebold (1929b: pl. 2, fig. 9), × 1. Fig. 7, side view of specimen figured by Frebold (1929b: pl. 2, fig. 8), × 1.	485
8	*Prosphingites czekanowskii* Mojsisovics Topotype specimen, MCZ 8677, × 1.5.	405

Specimens of Figures 1–7 are from upper Scythian horizon at Cape Thorson, Isfjord, Spitsbergen; specimen of Figure 8 is from the mouth of the Olenek River, Siberia.

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PLATE 27. METADAGNOCERAS and PSEUDOCELTITES

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1–4 *Metadagnoceras tobini* n. sp. 461

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5–10 *Pseudoceltites multiplicatus* (Waagen) 440

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Specimens of Figures 1–4 are from the Tobin Formation, Tobin Range, Nevada; specimens of Figures 5–10 are from the Mianwali Formation, Salt Range, West Pakistan.

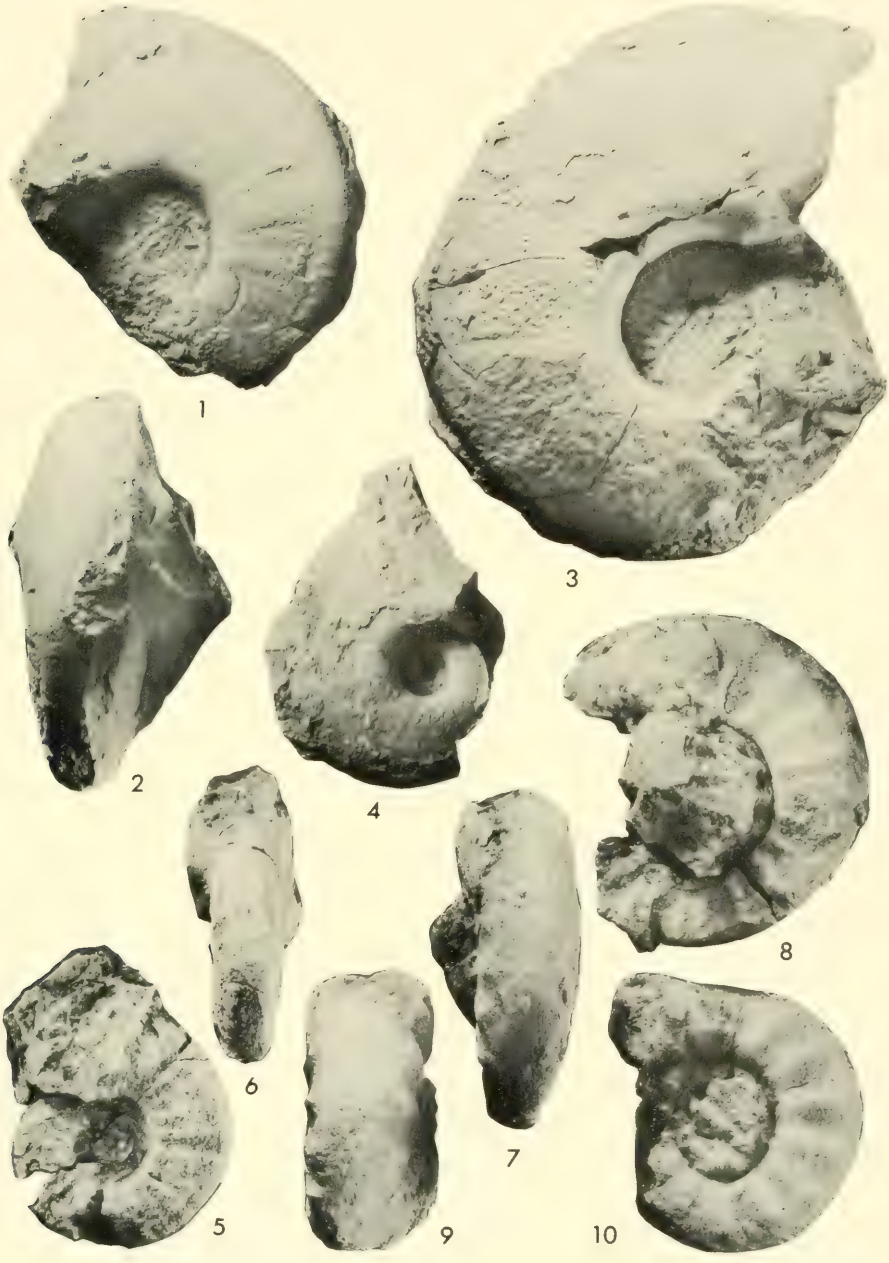

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PLATE 28. STACHEITES FLOWERI

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1–10 *Stacheites floweri* n. sp. 456

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All specimens are from the Tobin Formation, Tobin Range, Nevada.

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11, 12	*Hemilecanites paradiscus* n. sp.	375
	Paratype, MCZ 9451, × 2.	
	All specimens are from the Tobin Formation, Tobin Range, Nevada.	

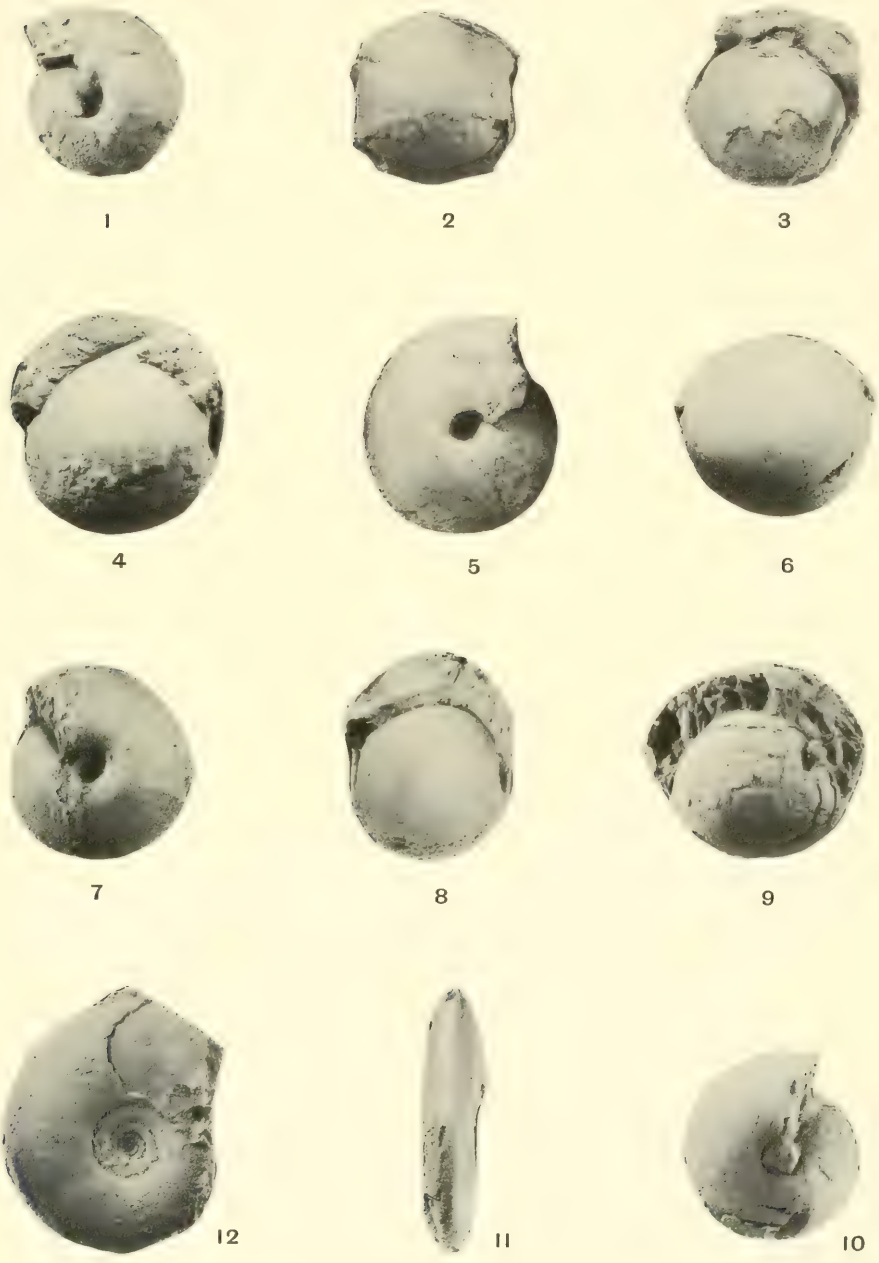

Plate 29

PLATE 30. SUBCOLUMBITES AMERICANUS

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1–14 *Subcolumbites americanus* n. sp. 436

Figs. 1, 2, holotype, MCZ 9430, × 1. Fig. 3, paratype, MCZ 9431, × 1. Fig. 4, paratype, MCZ 9432, × 1.5. Fig. 5, paratype, MCZ 9433, × 1. Figs. 6, 7, paratype, MCZ 9434, × 1. Fig. 8, paratype, MCZ 9435, × 1. Figs. 9, 10, paratype, MCZ 9436, × 1.5. Figs. 11, 12, paratype, MCZ 9437, × 1.5. Figs. 13, 14, paratype, MCZ 9438, × 1.5.

All specimens are from the Tobin Formation, Tobin Range, Nevada.

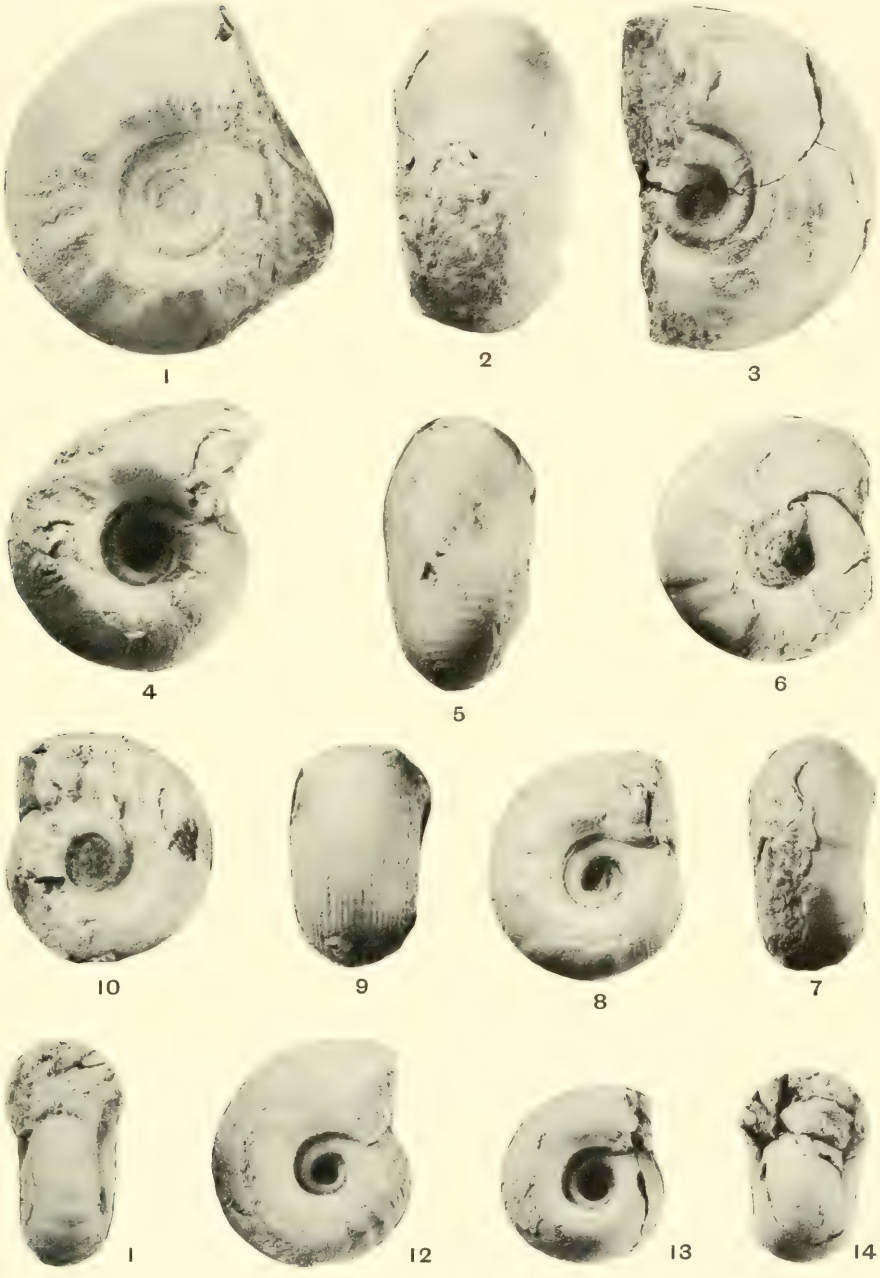


Plate 30

PLATE 31. ARNAUTOCELTITES, USSURITES, and HEMILECANITES

Figures		Page
1–7, 9, 10, 13, 14	*Arnautoceltites techerti* n. sp.	402
	Figs. 1, 2, holotype, MCZ 9457, × 1.5. Figs. 3, 4, paratype, MCZ 9458, × 1.5. Fig. 5, paratype, MCZ 9459, × 1.5. Figs. 6, 7, paratype, MCZ 9460, × 1.5. Figs. 9, 10, paratype, MCZ 9461, × 1.5. Figs. 13, 14, paratype, MCZ 9462, × 1.5.	
8	*Ussurites sieveri* n. sp.	528
	Paratype, MCZ 9464, × 1.5.	
11, 12	*Subcolumbites americanus* n. sp.	436
	Paratype, MCZ 9463, × 1.	
15, 16	*Hemilecanites paradiscus* n. sp.	375
	Holotype, MCZ 9465, × 1.5.	
	All specimens are from the Tobin Formation, Tobin Range, Nevada.	

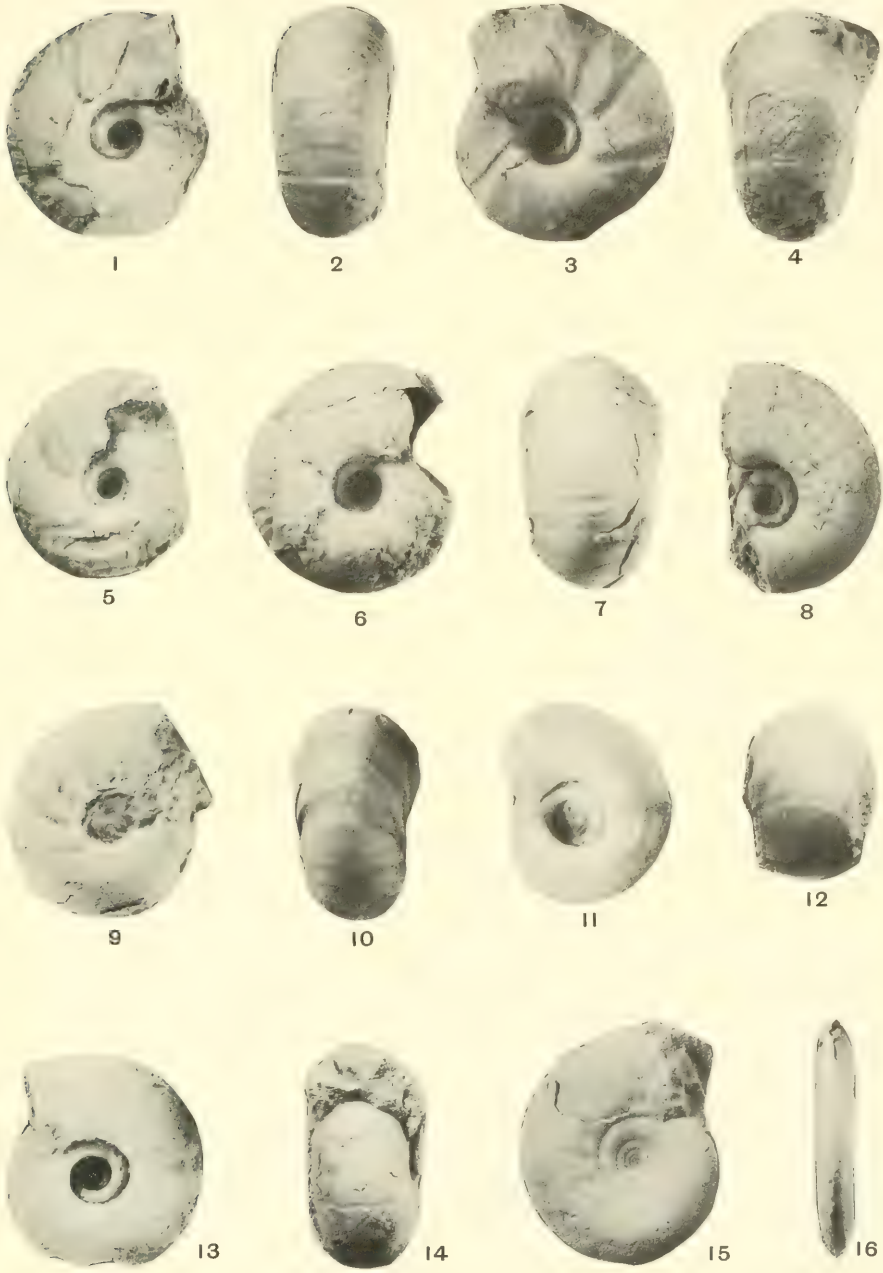


Plate 31

PLATE 32. USSURITES SIEVERI

Figures | Page

1–7 *Ussurites sieveri* n. sp. 528

Figs. 1, 2, holotype, MCZ 9452, × 1. Fig. 3, paratype, MCZ 9453, × 1. Fig. 4, paratype, MCZ 9454, × 1. Fig. 5, paratype, MCZ 9455, × 1. Figs. 6, 7, paratype, MCZ 9456, × 1.

All specimens are from the Tobin Formation, Tobin Range, Nevada.

Plate 32

PLATE 33. USSURITES HOSEI

Figures | Page

1–6 *Ussurites hosei* n. sp. 528

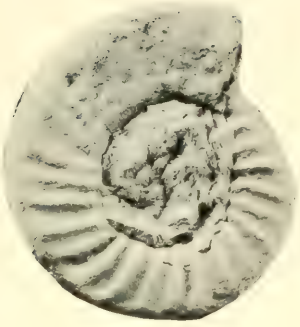
Fig. 1, holotype, USNM 153085, × 1. Fig. 2, paratype, USNM 153086, × 2. Figs. 3, 4, paratype, USNM 153087, × 1. Figs. 5, 6, paratype, USNM 153088, × 1.

All specimens are from the USGS collection M111, Confusion Range, Utah. From section 15 of Hose and Repenning (1959).

Plate 33

PLATE 34. PSEUDOCELTITES, PSEUDOSAGECERAS, and TIROLITES

Figures		Page
1–5	*Pseudoceltites nevadi* n. sp. Fig. 1, side view of holotype, USNM 153078, × 1. Figs. 2, 3, side and ventral view of fragment of paratype, USNM 153079, × 1. Figs. 4, 5, side and ventral view of fragment of paratype, USNM 153080, × 1.	440
6	*Pseudosageceras multilobatum* Noetling Side view, USNM 153072, × 1.	361
7–10	*Tirolites* cf. *cassianus* (Quenstedt) Figs. 7, 8, side and ventral view of portion of body chamber, USNM 153083, × 1. Figs. 9, 10, side and ventral view of fragmentary specimen, USNM 153084, × 1. All specimens are from the USGS Collection M111, Thaynes Formation, Confusion Range, Utah, associated with *Ussurites hosei* n. sp.	503



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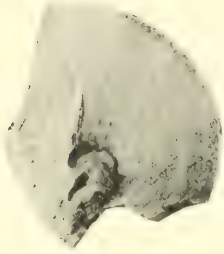

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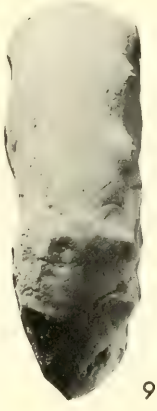

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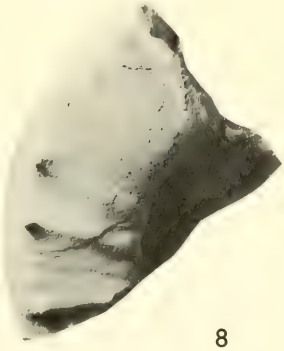

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Plate 34

PLATE 35. PROHUNGARITES, EPICELTITES, USSURITES, and HEMILECANITES

Figures		Page
1–5, 8, 9	*Prohungarites mckelvei* n. sp. Figs. 1, 2, holotype, MCZ 9466, × 1. Figs. 3, 4, paratype, MCZ 9467, × 1.5. Fig. 5, paratype, MCZ 9468, × 1.5. Figs. 8, 9, paratype, MCZ 9469, × 1.	520
6, 7	*Epiceltites gentii* (Arthaber) Fig. 6, plesiotype, MCZ 9470, × 1.5. Fig. 7, plesiotype, MCZ 9471, × 1.5.	447
10, 11	*Ussurites sieveri* n. sp. Paratype, MCZ 9472, × 1.5.	528
12	*Hemilecanites paradiscus* n. sp. Paratype, MCZ 9473, × 1.5.	375

Figures 1–9 are from the upper member of Thaynes Formation, Hammond Creek, Bear River Range, southeast Idaho. Figures 10–12 are from Tobin Formation, Tobin Range, Nevada.

Plate 35

PLATE 36. PROHUNGARITES, OLENEKITES, and ISCULITOIDES

Figures		Page
1, 2	*Prohungarites* sp. indet. MCZ 9474, × 1.	522
3	*Prohungarites gutstadti* n. sp. Side view of holotype, MCZ 9475, × 1.	521
4–7	*Olenekites* cf. *spiniplicatus* (Mojsisovics) Figs. 4, 5, plesiotype, MCZ 9482, × 1.5. Figs. 6, 7, plesiotype, MCZ 9476, × 1.5.	489
8–13	*Isculitoides hammondi* n. sp. Fig. 8, holotype, MCZ 9477, × 1.5. Figs. 9, 10, paratype, MCZ 9478, × 1.5. Fig. 11, paratype, MCZ 9479, × 1.5. Figs. 12, 13, paratype, MCZ 9480, × 1.5.	419
14, 15	*Prohungarites gutstadti* n. sp. Side and ventral view of paratype, MCZ 9481, × 2.	521

All specimens are from the upper member of Thaynes Formation, Hammond Creek, Bear River Range, southeast Idaho.

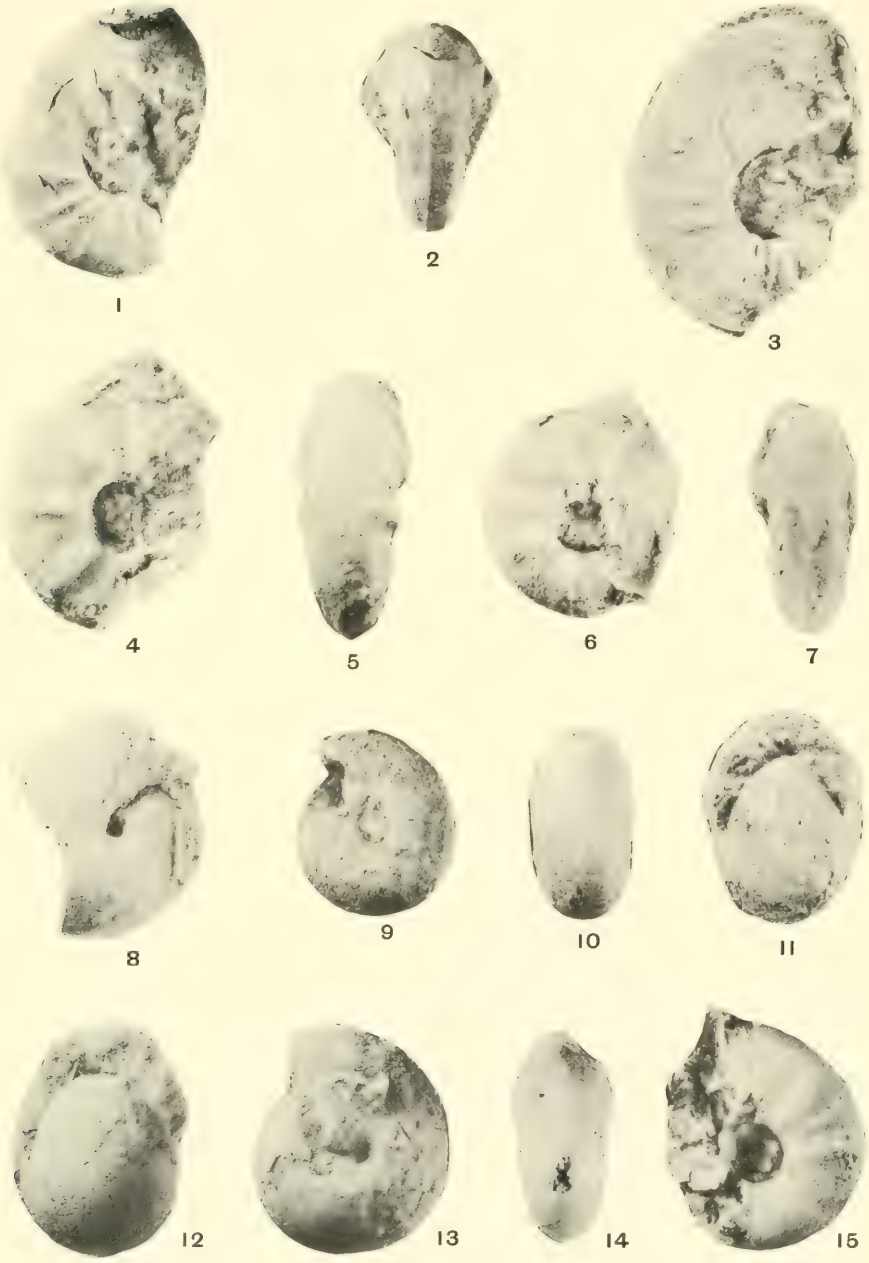
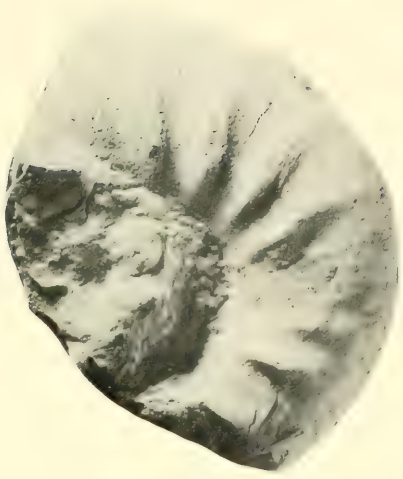


Plate 36

PLATE 37. KEYSERLINGITES and STACHEITES

Figures		Page
1–4	*Keyserlingites bearriverensis* n. sp. Figs. 1, 2, side and ventral view of holotype, MCZ 9520, × 1. Figs. 3, 4, side and ventral view of paratype, MCZ 9521, × 1.	487
5, 6	*Keyserlingites bearlakensis* n. sp. Side and ventral view of paratype, MCZ 9518, × 3.	486
7, 8	*Stacheites* sp. indet. I Side and ventral view, MCZ 9487, × 1.	456
9, 10	*Stacheites* sp. indet. II Side and ventral view, MCZ 9501, × 1.	457

Specimens of Figures 1–8 came from the upper member of Thaynes Formation, Hammond Creek, Bear River Range, southeastern Idaho; specimens of Figures 9, 10 came from the upper part of Thaynes Formation, Sublette Ridge, Wyoming.



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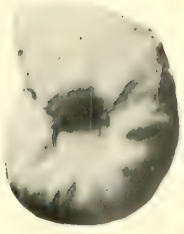

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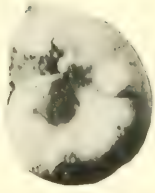

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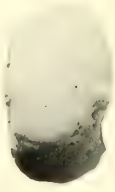

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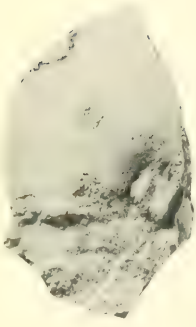

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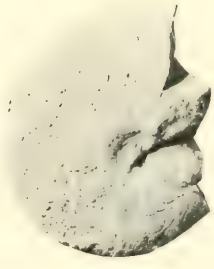

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Plate 37

PLATE 38. KEYSERLINGITES and PROHUNGARITES

Figures | Page

1–3 *Keyserlingites bearlakensis* n. sp. 486
Figs. 1, 2, side and ventral view of holotype, MCZ 9516, × 1. Fig. 3, side view of paratype, MCZ 9517, × 1.

4, 5 *Prohungarites* sp. indet. 522
Side and ventral view, MCZ 9647, × 1.
All specimens are from the upper Thaynes Formation, Hammond Creek, Bear River Range, southeast Idaho.

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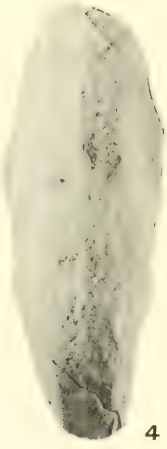

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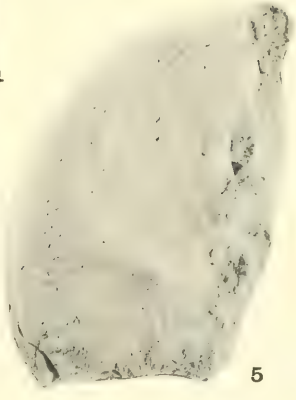

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Plate 38

PLATE 39. COLUMBITES PARISIANUS

Figures | Page

1–10 *Columbites parisianus* Hyatt and Smith 424

Figs. 1, 2, front and side view of paratype, Hyatt and Smith (1905: pl. 61, figs. 2, 3), USNM 75286b, × 1. Figs. 3, 4, front and side view of holotype, Hyatt and Smith (1905: pl. 1, figs. 9, 10), USNM 75246a, × 1. Figs. 5–7, front, ventral, and side views of paratype, Hyatt and Smith (1905: pl. 61, figs. 5–7), USNM 75286c, × 1. Figs. 8, 9, front and side view of paratype, Hyatt and Smith (1905: pl. 1, figs. 12–14), USNM 75246b, × 1. Fig. 10, front view of paratype, Hyatt and Smith (1905: pl. 61, fig. 10), USNM 75286e, × 1. All specimens are from the middle shale member of Thaynes Formation (*Columbites* fauna), Paris Canyon, Bear River Range, southeast Idaho.

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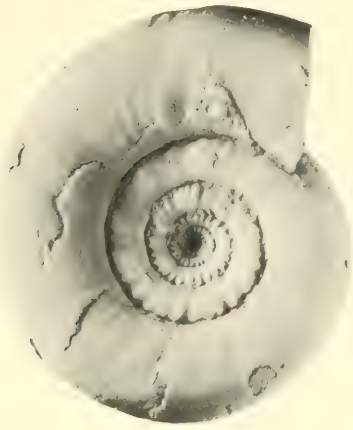

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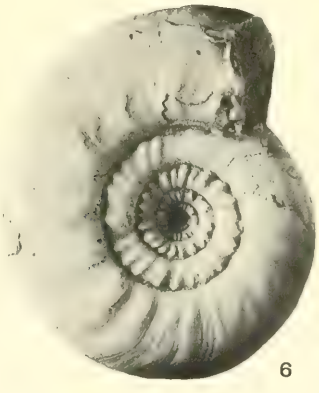

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Plate 39

PLATE 40. COLUMBITES PARISIANUS

Figures | Page

1–11 *Columbites parisianus* Hyatt and Smith 424

Figs. 1, 2, front and side view of holotype of *Columbites ornatus* Smith (1932: pl. 46, figs. 14, 15), USNM 74984a, × 1. Figs. 3, 4, front and side view of paratype of *Columbites spencei* Smith (1932: pl. 78, figs. 13–15), USNM 75309g, × 2. Figs. 5, 6, front and side view of paratype of *Columbites spencei* Smith (1932: pl. 78, figs. 11, 12), USNM 75309f, × 2. Figs. 7–9, side, ventral, and front view of paratype of *Columbites ligatus* Smith (1932: pl. 47, figs. 6–8), USNM 74985c, × 1. Figs. 10, 11, side and ventral view of paratype of *Columbites ornatus* Smith (1932: pl. 46, figs. 16, 17), USNM 74984b, × 1.

All specimens are from the middle shale member of Thaynes Formation (*Columbites* fauna), Paris Canyon, Bear River Range, southeast Idaho.

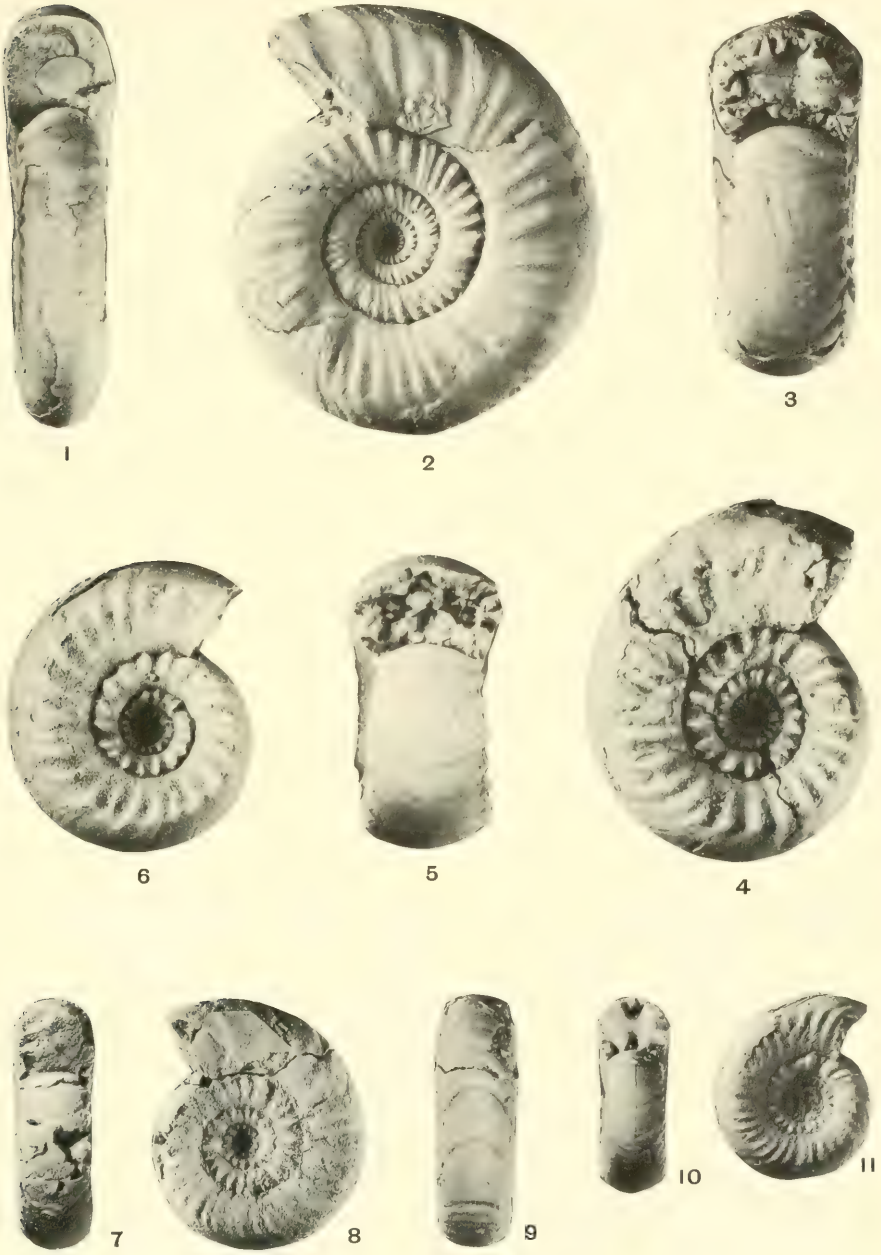

Plate 40

PLATE 41. COLUMBITES PARISIANUS

Figures | Page

1–7 *Columbites parisianus* Hyatt and Smith 424

Figs. 1, 2, front and side view of holotype of *Columbites consanguineus* Smith (1932: pl. 46, figs. 1, 2), USNM 74983a, × 1. Figs. 3, 4, ventral and side view of paratype of *Columbites consanguineus* Smith (1932: pl. 46, figs. 3, 4), USNM 74983b, × 1. Figs. 5, 6, front and side view of paratype of *Columbites consanguineus* Smith (1932: pl. 46, figs. 5, 6), USNM 74983c, × 1. Fig. 7, side view of paratype of *Columbites parisianus* Hyatt and Smith (1904: pl. 61, fig. 1), USNM 75286a, × 1.

All specimens are from the middle shale member of Thaynes Formation (*Columbites* fauna) Paris Canyon, Bear River Range, southeast Idaho.

Plate 41

PLATE 42. COLUMBITES PARISIANUS

Figures | Page

1–9 *Columbites parisianus* Hyatt and Smith — 424

Figs. 1, 2, front and side view of holotype of *Columbites spencei* Smith (1932: pl. 78, figs. 1, 2), USNM 75309a, × 1. Figs. 3, 4, front and side view of paratype of *Columbites spencei* Smith (1932: pl. 78, figs. 5, 6), USNM 75309c, × 1. Figs. 5, 6, front and side view of paratype of *Columbites spencei* Smith (1932: pl. 78, figs. 9, 10), USNM 75309e, × 2. Fig. 7, side view of paratype of *Columbites ligatus* Smith (1932: pl. 47, fig. 4), USNM 74985b, × 1. Figs. 8, 9, front and side view of paratype of *Columbites spencei* Smith (1932: pl. 78, figs. 7, 8), USNM 75309d, × 1.

All specimens are from the middle shale member of Thaynes Formation (*Columbites* fauna), Paris Canyon, Bear River Range, southeast Idaho.

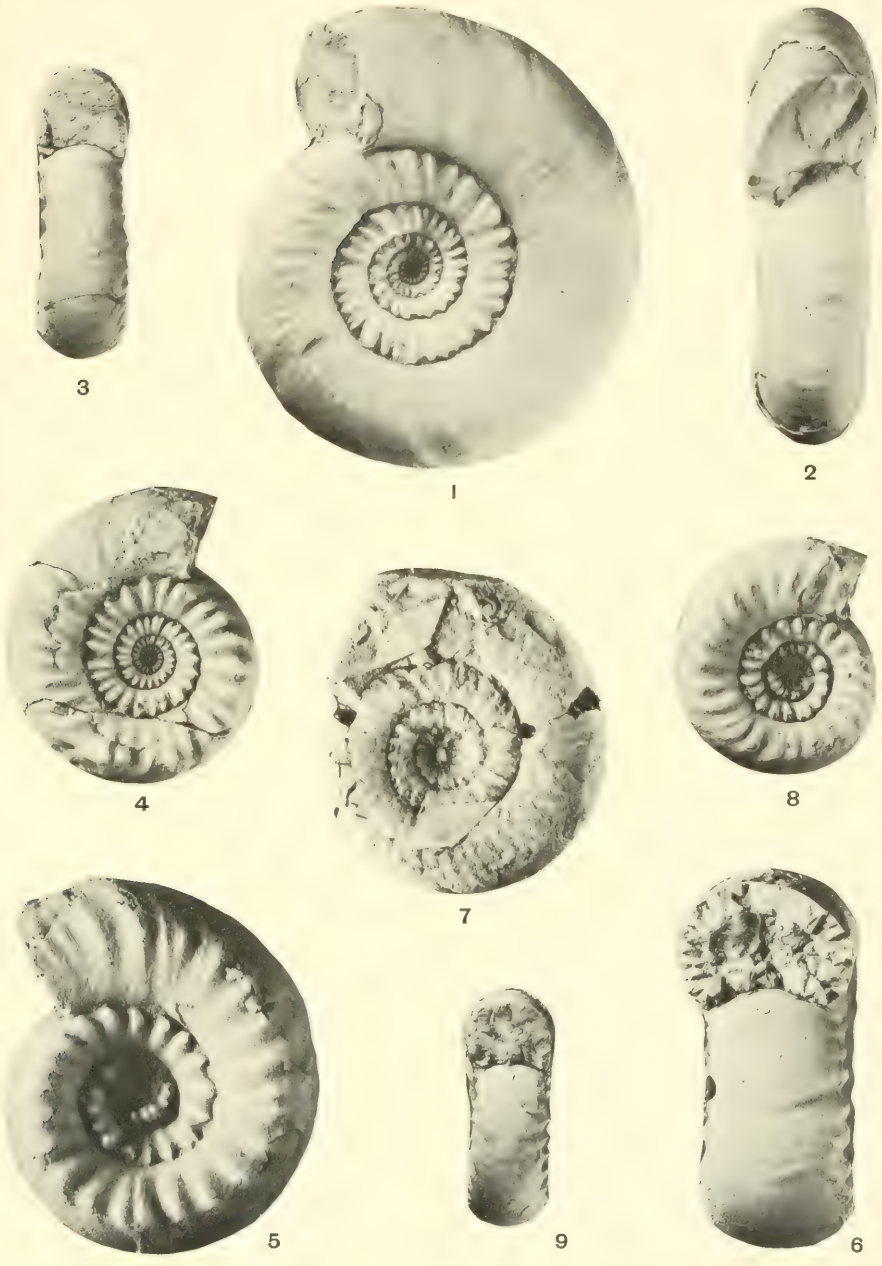

Plate 42

PLATE 43. SVALBARDICERAS, PREFLORIANITES, and COLUMBITES

Figures		Page
1	*Svalbardiceras sheldoni* n. sp. Side view of holotype, MCZ 9493, × 1.	453
2, 3	*Preflorianites montpelierensis* n. sp. Side and ventral view of paratype, MCZ 9495, × 1.5.	382
4, 5	*Columbites parisianus* Hyatt and Smith Side and front view of holotype of *Columbites ligatus* Smith (1932: pl. 47, figs. 1–3), USNM 74985a, × 1.	425

All specimens are from the middle shale member of Thaynes Formation (*Columbites* fauna), southeast Idaho. Specimen of Figure 1 from Sage Creek, of Figures 2, 3 from Montpelier Canyon, and of Figures 4, 5 from Paris Canyon.

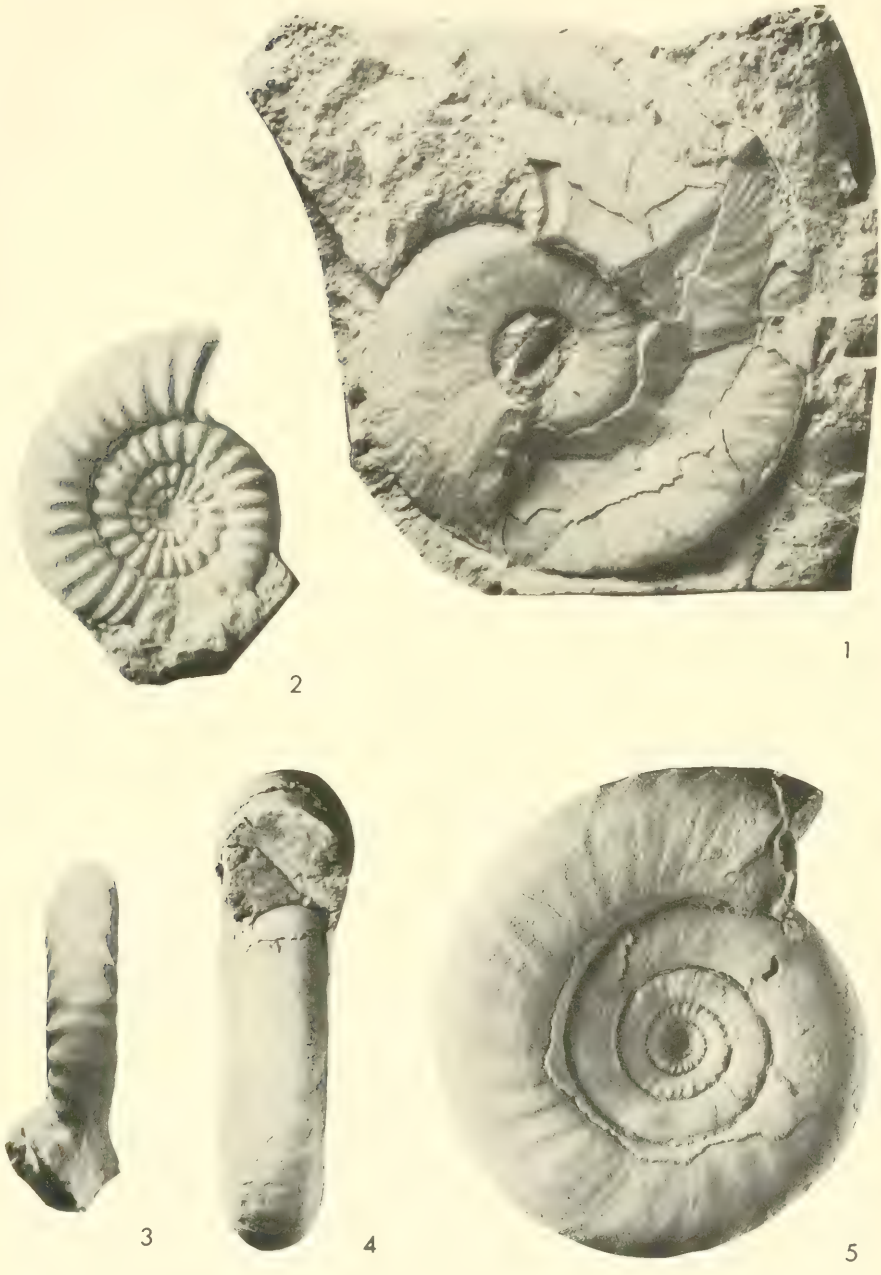

Plate 43

PLATE 44. USSURITES, PSEUDOCELTITES, PREFLORIANITES, and PSEUDASPIDITES

Figures		Page
1–3	*Ussurites mansfieldi* n. sp.	530
	Fig. 1, side view of paratype, MCZ 9515, × 1. Figs. 2, 3, ventral and side view of paratype, MCZ 9513, × 1.	
4–10	*Pseudoceltites cheneyi* n. sp.	438
	Fig. 4, paratype, MCZ 9503, × 1. Fig. 5, paratype, MCZ 9504, × 1. Figs. 6, 7, paratype, MCZ 9505, × 1. Figs. 8, 9, holotype, USNM 153073, × 1. Fig. 10, paratype, MCZ 9506, × 1.	
11–13	*Preflorianites montpelierensis* n. sp.	382
	Fig. 11, paratype, MCZ 9635, × 1. Fig. 12, paratype, MCZ 9498, × 1. Fig. 13, holotype, MCZ 9494, × 1.	
14–15	*Pseudaspidites popovi* n. sp.	383
	Side and ventral view of juvenile specimen, MCZ 9636, × 1.	
	All specimens came from the middle shale member of Thaynes Formation (*Columbites* fauna), southeast Idaho. Specimens of Figures 8, 9, from Draney Creek, of Figure 13 from Montpelier Canyon, all others from Hot Springs.	

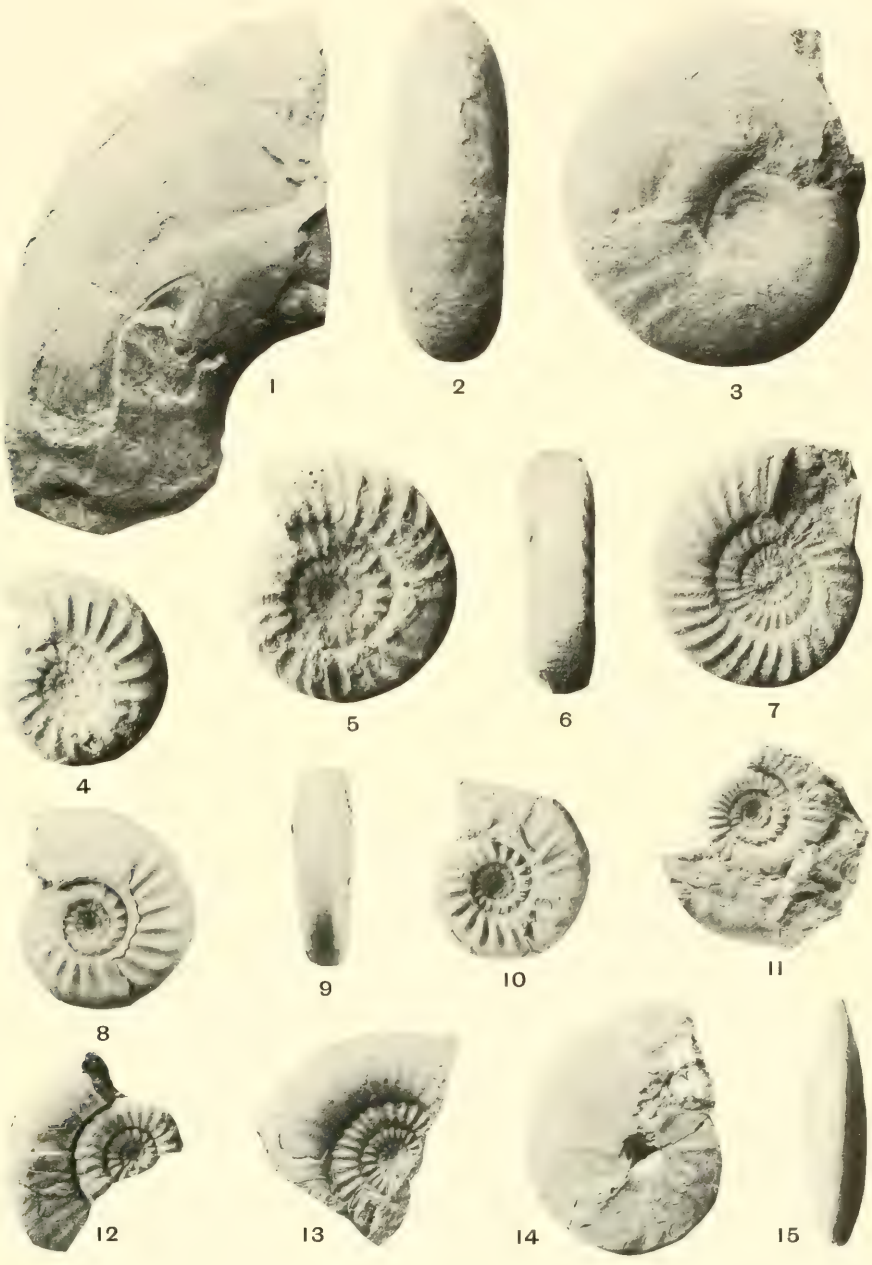

Plate 44

PLATE 45. USSURITES MANSFIELDI

Figures

1–3 *Ussurites mansfieldi* n. sp. Page 530

Fig. 1, holotype, × 0.5. Figs. 2, 3, paratype, × 0.8.

Both specimens are from the middle shale member of Thaynes Formation (*Columbites* fauna) in Webster Canyon, southeast Idaho, and are deposited in the Department of Geology, Washington State University.

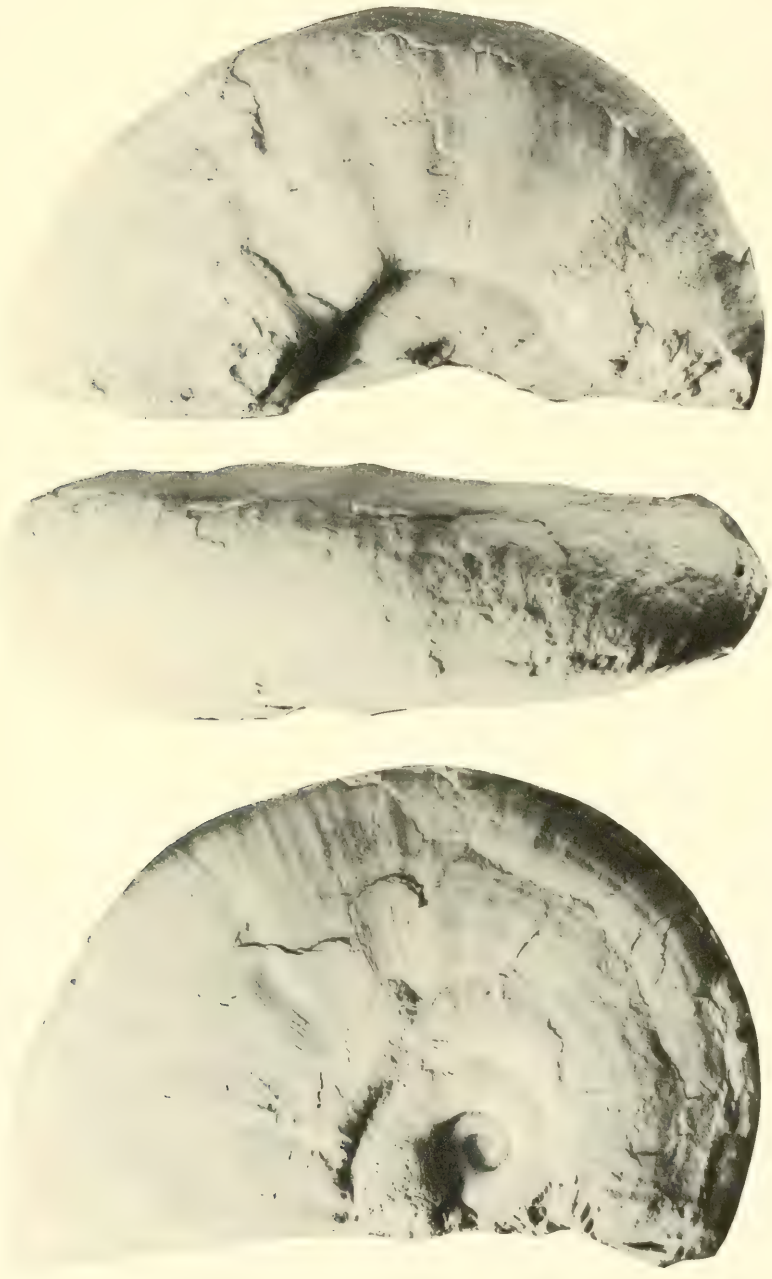

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Plate 45

PLATE 46. KEYSERLINGITES and NORDOPHICERAS

Figures | Page

1 *Keyserlingites stephensoni* n. sp. 487
Side view of the holotype deposited in Department of Geology, Washington State University. Specimen is presumably from the *Columbites* fauna, Fort Hall Indian Reservation, southeast Idaho, × 0.3.

2, 3 *Nordophiceras pilatum* (Hyatt and Smith) 470
Fig. 2, MCZ 9543, × 1.5. Fig. 3, MCZ 9544, × 1.5.
Both specimens are from the middle shale member of Thaynes Formation (*Columbites* fauna) southeast Idaho, Figure 2, from Montpelier Canyon, Figure 3, from Hot Springs.

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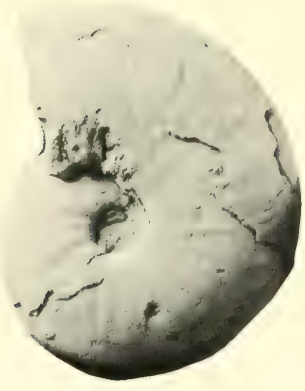

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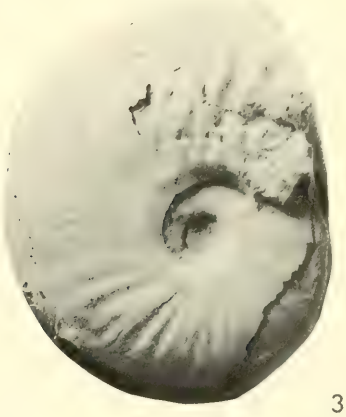

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Plate 46

PLATE 47. NORDOPHICERAS

Figures — Page

1–5 *Nordophiceras jacksoni* (Hyatt and Smith) — 468
Fig. 1, MCZ 9564, × 1. Fig. 2, MCZ 9565, × 1. Fig. 3, MCZ 9566, × 3. Fig. 4, MCZ 9567, × 1.5. Fig 5, MCZ 9568, × 1.5.
All specimens are from the middle shale member of Thaynes Formation (*Columbites* fauna), southeast Idaho. Specimen of Figure 1 is from Montpelier Canyon, Figure 2 is from Paris Canyon, and the others are from Hot Springs.

6–8 *Nordophiceras euomphalus* (Keyserling) — 465
Fig. 6, MCZ 9655, × 1. Figs. 7, 8, MCZ 8680, × 1.5.
Topotype specimens are from the Olenekian fauna, Olenek River, Siberia.

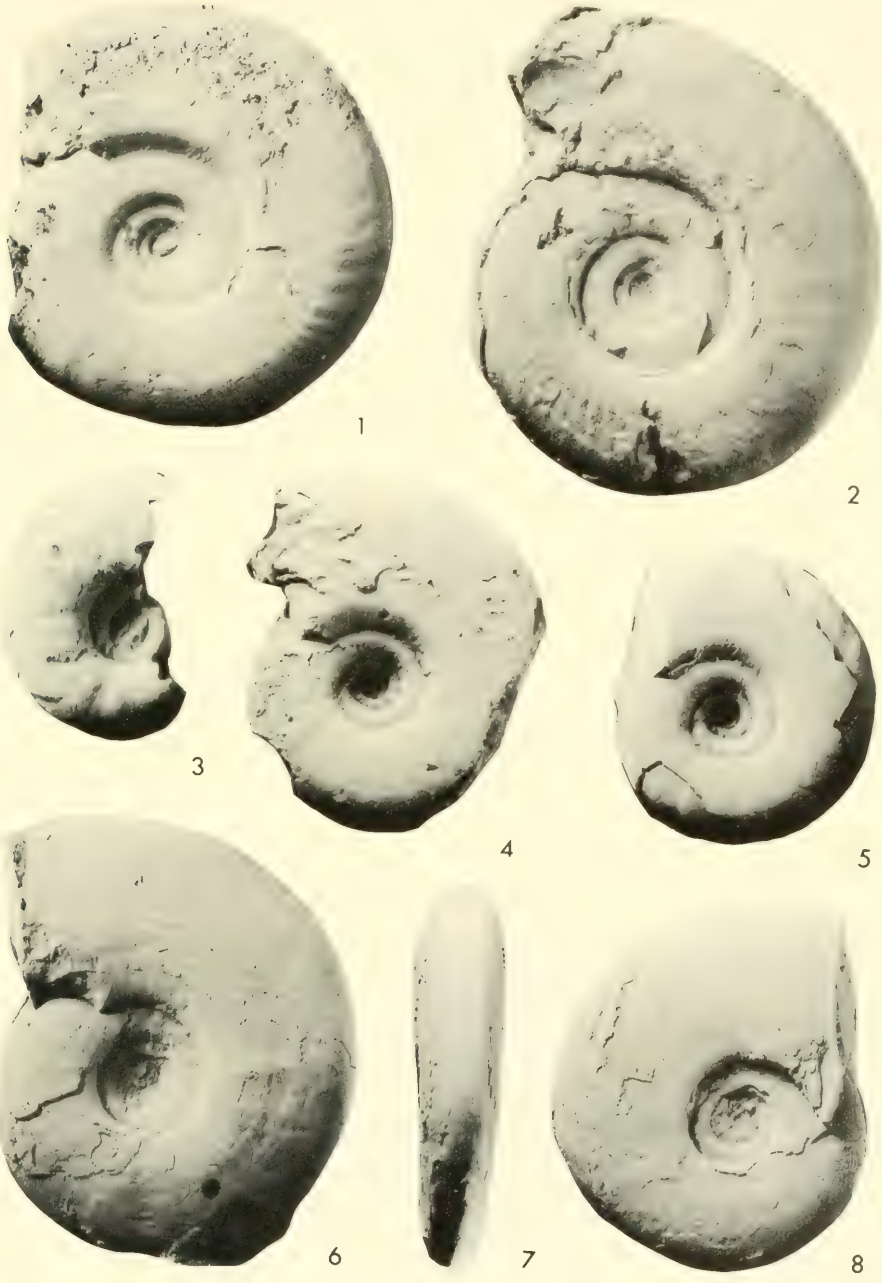

Plate 47

PLATE 48. NORDOPHICERAS and XENOCELTITES

Figures — Page

1–4 *Nordophiceras jacksoni* (Hyatt and Smith) — 468

Figs. 1, 2, side and front view of paratype (Hyatt and Smith, 1905: pl. 62, figs. 15, 16), USNM 75292c, × 1.

Figs. 3, 4, side and front view of holotype (Hyatt and Smith, 1905: pl. 62, figs. 11–13), USNM 75292a, × 1.

5–9 *Xenoceltites spencei* (Hyatt and Smith) — 376

Figs. 5, 6, side and front view of paralectotype (Hyatt and Smith, 1905: pl. 62, figs. 5–7), USNM 75291b, × 1.

Figs. 7–9, side, front, and ventral view ot lectotype (Hyatt and Smith, 1905: pl. 62, figs. 1–3), USNM 75291a, × 1.

All specimens are from the middle shale member of Thaynes Formation (*Columbites* fauna), Paris Canyon, Bear River Range, southeast Idaho.

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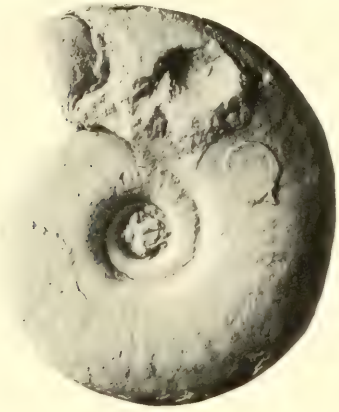

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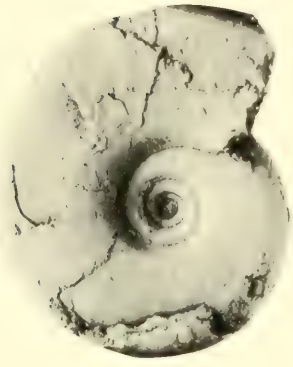

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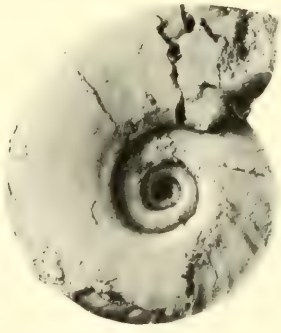

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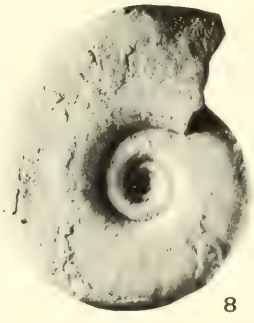

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PLATE 49. NORDOPHICERAS PILATUM

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1–8 *Nordophiceras pilatum* (Hyatt and Smith) 470

Fig. 1, side view of paratype of *Meekoceras sanctorum* Smith (1932: pl. 49, fig. 3), USNM 74991b, × 1. Figs. 2, 3, side and front view of holotype of *Meekoceras sanctorum* Smith (1932: pl. 49, figs. 1, 2), USNM 74991a, × 1. Figs. 4–6, side, front, and ventral view of paralectotype of *Meekoceras pilatum* Hyatt and Smith (1905: pl. 63, figs. 10–12), USNM 75294b, × 1. Figs. 7, 8, side and ventral view of lectotype of *Meekoceras pilatum* Hyatt and Smith (1905: pl. 63, figs. 7, 8), USNM 75294a, × 1.

All specimens are from the middle shale member of Thaynes Formation (*Columbites* fauna), Paris Canyon, Bear River Range, southeast Idaho.

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PLATE 50. NORDOPHICERAS PILATUM

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1–11 *Nordophiceras pilatum* (Hyatt and Smith) 470

Figs. 1, 2, side and front view of holotype of *Meekoceras curticostatum* Smith (1932: pl. 48, figs. 21–22), USNM 74990a, × 1. Fig. 3, side view of paratype of *Meekoceras curticostatum* Smith (1932: pl. 48, figs. 27, 28), USNM 74990d, × 1. Fig. 4, side view of paratype of *Meekoceras curticostatum* Smith (1932: pl. 48, figs. 29, 30), USNM 74990e, × 2. Fig. 5, side view of paratype of *Meekoceras curticostatum* Smith (1932: pl. 48, figs. 25, 26), USNM 74990c, × 1. Fig. 6, side view of paratype of *Meekoceras curticostatum* Smith 1932: pl. 48, figs. 23, 24), USNM 74990b, × 1. Figs. 7–9, side, front, and ventral view of holotype of *Meekoceras micromphalus* Smith (1932: pl. 49, figs. 5–7), USNM 74992a, × 1. Figs. 10, 11, side and front view of paratype of *Meekoceras micromphalus* Smith (1932: pl. 49, figs. 9–11), USNM 74992b, × 2.
All specimens are from the middle shale member of Thaynes Formation (*Columbites* fauna), Paris Canyon, Bear River Range, southeast Idaho.

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PLATE 51. NORDOPHICERAS and CORDILLERITES

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6, 7	*Cordillerites angulatus* Hyatt and Smith	364
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All specimens are from the middle shale member of Thaynes Formation (*Columbites* fauna), Montpelier Canyon, southeast Idaho.

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PLATE 52. XENOCELTITES SPENCEI

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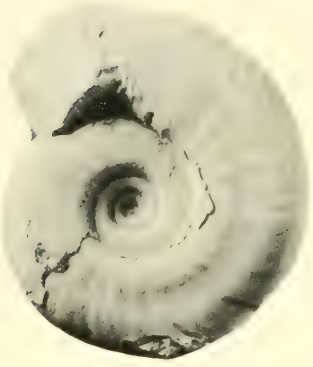
1–7 *Xenoceltites spencei* (Hyatt and Smith) 376

Fig. 1, MCZ 9551, × 1. Fig. 2, MCZ 9552, × 2. Fig. 3, MCZ 9553, × 1.5. Fig. 4, MCZ 9554, × 1.5. Fig. 5, MCZ 9555, × 2. Fig. 6, MCZ 9556, × 1.5. Fig. 7, MCZ 9557, × 3.

All specimens are from the middle shale member of Thaynes Formation (*Columbites* fauna), southeast Idaho. Specimens of Figures 1, 4, 6, and 7 are from Montpelier Canyon; specimens of Figures 2, 3, and 5 are from Hot Springs.



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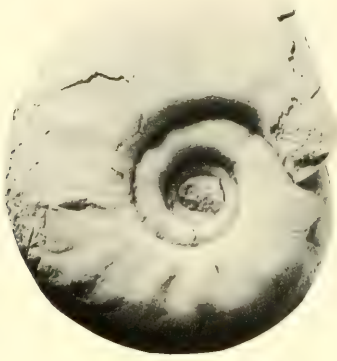

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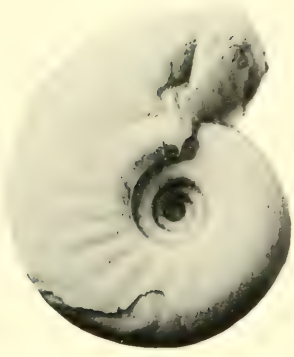

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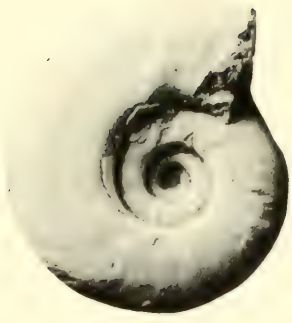

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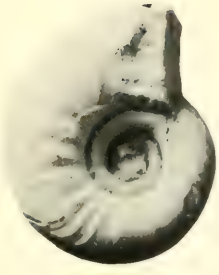

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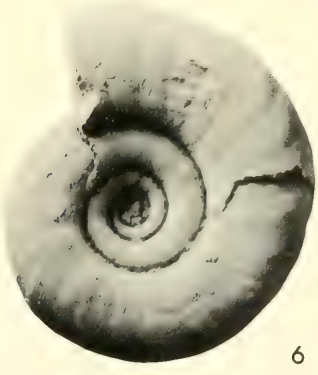

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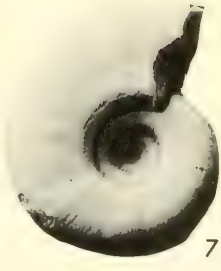

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PLATE 53. DIENEROCERAS, HELLENITES, and SUBVISHNUITES

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1–12	*Dieneroceras apostolicus* (Smith)	369
	Figs. 1, 2, side and front view of holotype of *Celtites ursensis* Smith (1932: pl. 47, figs. 11, 12), USNM 74987a, × 1. Figs. 3, 4, side and ventral view of paratype of *Celtites ursensis* Smith (1932: pl. 47, figs. 13, 14), USNM 74987b, × 1. Figs. 5, 6, side and front view of paratype of *Celtites ursensis* Smith (1932: pl. 47, figs. 15, 16), USNM 74987c, × 1. Figs. 7, 8, side and front view of holotype of *Celtites planovolvis* Smith (1932: pl. 48, figs. 11, 12), USNM 74988a, × 1. Fig. 9, side view of paratype of *Celtites planovolvis* Smith (1932: pl. 48, figs. 13, 14), USNM 74988b, × 1. Figs. 10, 11, side and front view of holotype of *Celtites apostolicus* Smith (1932: pl. 48, figs. 1, 2), USNM 74989a, × 1. Fig. 12, side view of paratype of *Celtites apostolicus* Smith (1932: pl. 48, figs. 3, 4), USNM 74989b, × 1.	
13, 14	*Hellenites idahoense* (Smith)	516
	Side and ventral view of holotype (Smith, 1932: pl. 49, figs. 17, 18), USNM 74994, × 2.	
15	*Subvishnuites* sp. indet.	374
	Side view, MCZ 9512, × 1.	
	All specimens are from the middle shale member of Thaynes Formation (*Columbites* fauna), Idaho. The specimens of Figures 1–14 are from Paris Canyon, and the specimen of Figure 15 is from Montpelier Canyon.	

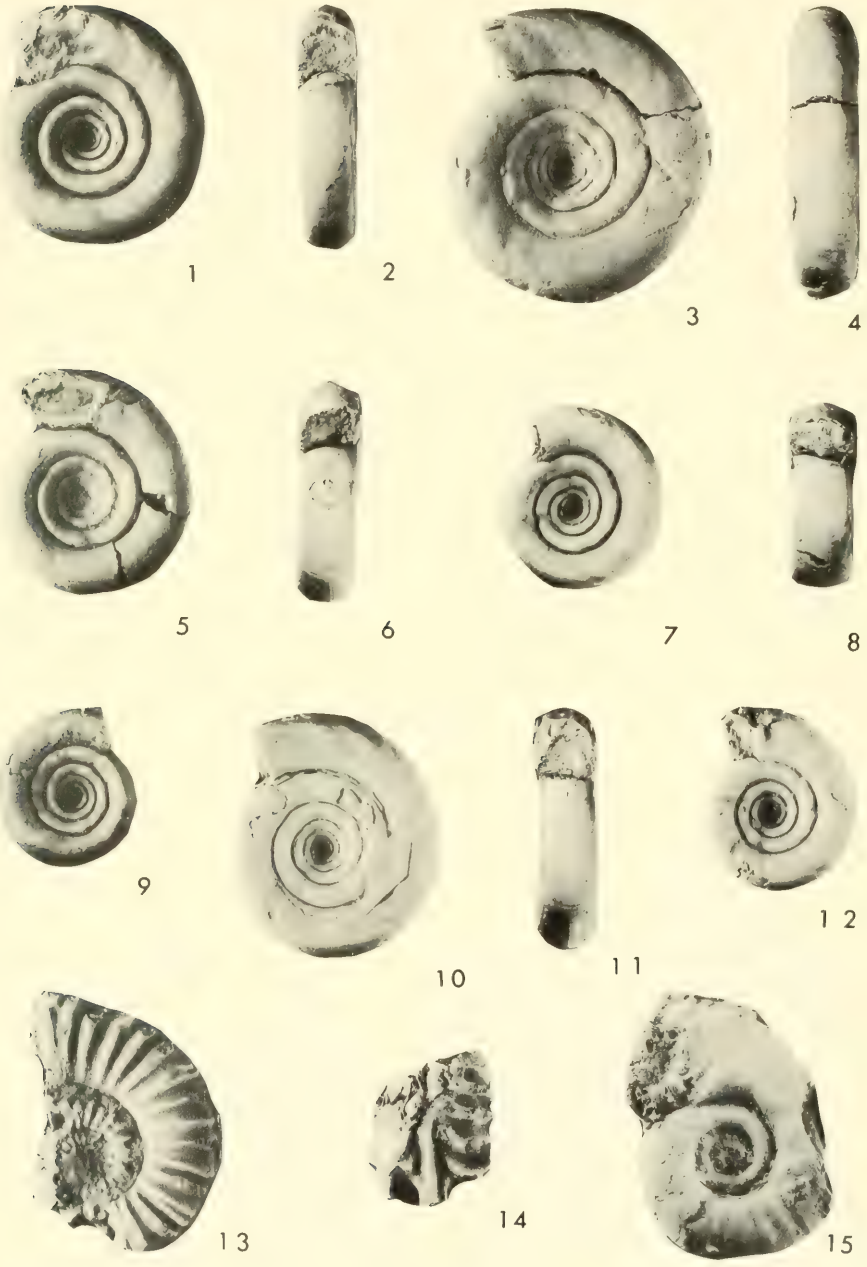

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PLATE 54. TIROLITES SMITHI

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1–5 *Tirolites smithi* n. sp. 501

Fig. 1, specimen from Montpelier Canyon, MCZ 9547, × 1. Figs. 2, 3, ventral and side view of *Tirolites illyricus* Mojsisovics from Paris Canyon, figured by Smith (1932: pl. 49, figs. 12, 13), USNM 74993, × 1. Figs. 4, 5, side and ventral view of juvenile form from Montpelier Canyon, MCZ 9548, × 1.

All specimens are from the middle shale member of Thaynes Formation (*Columbites* fauna), southeast Idaho.

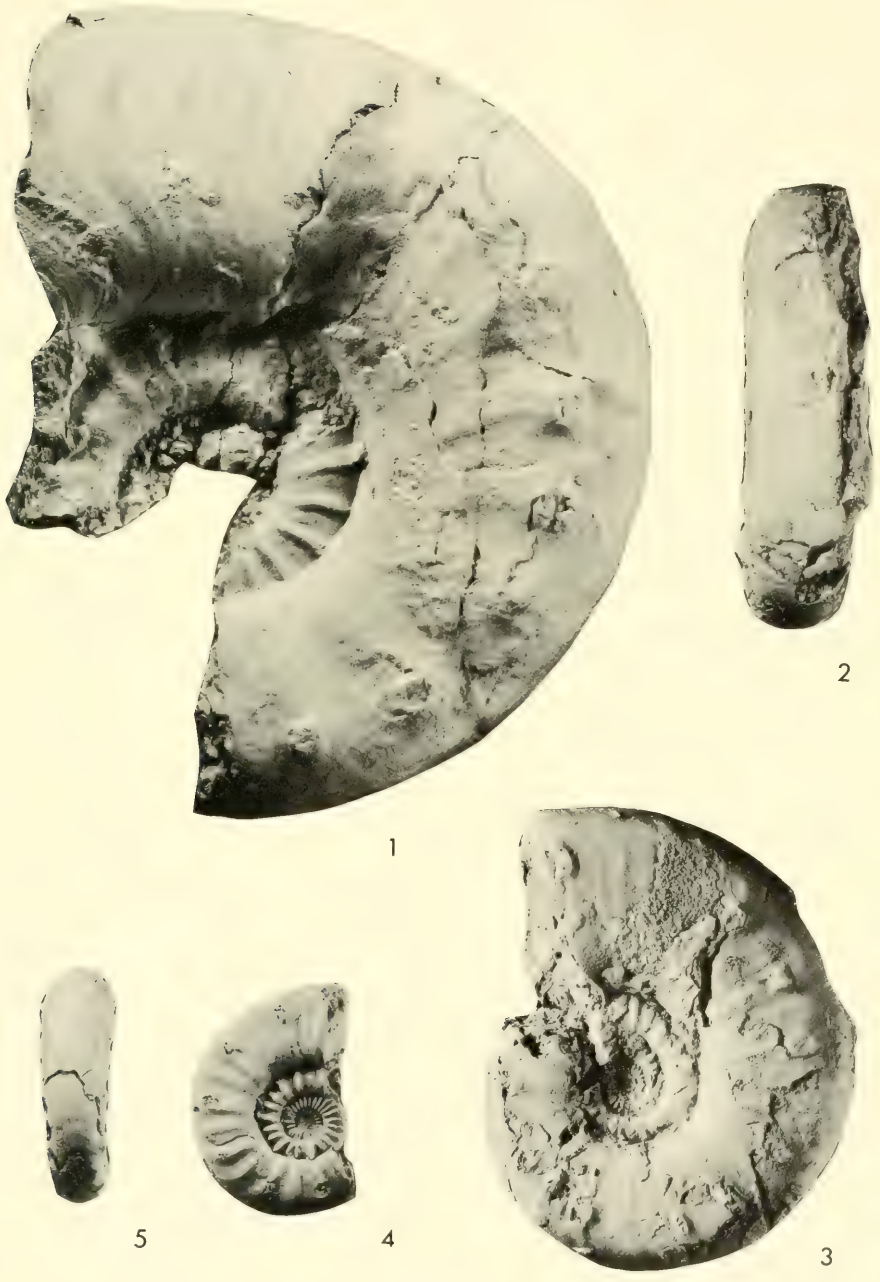

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PLATE 55. TIROLITES, DALMATITES, and PSEUDASPIDITES

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4, 5	*Tirolites* sp. indet. II Side and ventral view, MCZ 9502, × 1.	503
6, 7	*Dalmatites kittli* n. sp. Side and ventral view of holotype, MCZ 9499, × 1.5.	522
8, 9	*Pseudaspidites popovi* n. sp. Side and ventral view of holotype, MCZ 9575, × 1.	383

All specimens are from the middle shale member of Thaynes Formation (*Columbites* fauna), Idaho. Specimens of Figures 1–3, from Sage Creek, of Figures 4, 5, from Montpelier Canyon, of Figures 6, 7, from Paris Canyon, of Figures 8, 9, from Hot Springs.

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1–8	*Dalmatites morlaccus* Kittl Figs. 1, 2, lectotype, Kittl (1903: pl. 4, fig. 4), × 1. Figs. 3, 4, paralectotype, Kittl (1903: fig. 5), × 1. Figs. 5, 6, paralectotype, Kittl (1903: fig. 6), × 1. Figs. 7, 8, paralectotype, Kittl (1903: fig. 7), × 1.	522
9, 10	*Stacheites prionoides* Kittl Holotype, Kittl (1903: pl. 4, fig. 8), × 1.	455

All specimens are from the Werfen Formation at Muć, Dalmatia, and are deposited in the Natural History Museum, Vienna.

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PLATE 57. BITTNERITES and PSEUDODINARITES

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1–6 *Bittnerites bittneri* Kittl 504

Figs. 1, 2, lectotype, Kittl (1903: pl. 11, fig. 10), × 1. Figs. 3, 4, holotype, *Bittnerites malici* Kittl (1903: pl. 3, fig. 8), × 1. Figs. 5, 6, holotype, *Bittnerites telleri* Kittl (1903: pl. 10, fig. 10), × 1.

7–9 *Pseudodinarites mohamedanus* (Mojsisovics) 511

Figs. 7, 8, plesiotype,–Kittl (1903: pl. 3, fig. 7), × 1; Fig. 9, plesiotype,–Kittl (1903: pl. 3, fig. 6), × 1. All specimens are from the Werfen Formation at Muć, Dalmatia, and are deposited in the Natural History Institute, Vienna.

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PLATE 58. DINARITES DALMATINUS

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1–10 *Dinarites dalmatinus* (Hauer) 506

Fig. 1, plesiotype, *Dinarites nudus* Tommasi,–Kittl (1903: pl. 1, fig. 13), × 1. Fig. 2, plesiotype, *Dinarites laevis* Tommasi,–Kittl (1903: pl. 3, fig. 11), × 1. Figs. 3, 4, plesiotype, *Dinarites laevis* Tommasi,–Kittl (1903: pl. 3, fig. 10), ×1. Figs. 5, 6, plesiotype, *Dinarites dalmatinus* (Hauer),–Kittl (1903: pl. 2, fig. 1), × 1. Fig. 7, plesiotype, *Dinarites dalmatinus* (Hauer),–Kittl (1903: pl. 2, fig. 5), × 1. Fig. 8, plesiotype, *Dinarites dalmatinus* (Hauer),–Kittl (1903: pl. 2, fig. 6), × 1. Figs. 9, 10, plesiotype, *Dinarites dalmatinus* (Hauer),–Kittl (1903: pl. 2, fig. 3), × 1.

All specimens are from the Werfen Formation at Muć, Dalmatia, and are deposited in the Natural History Museum, Vienna.

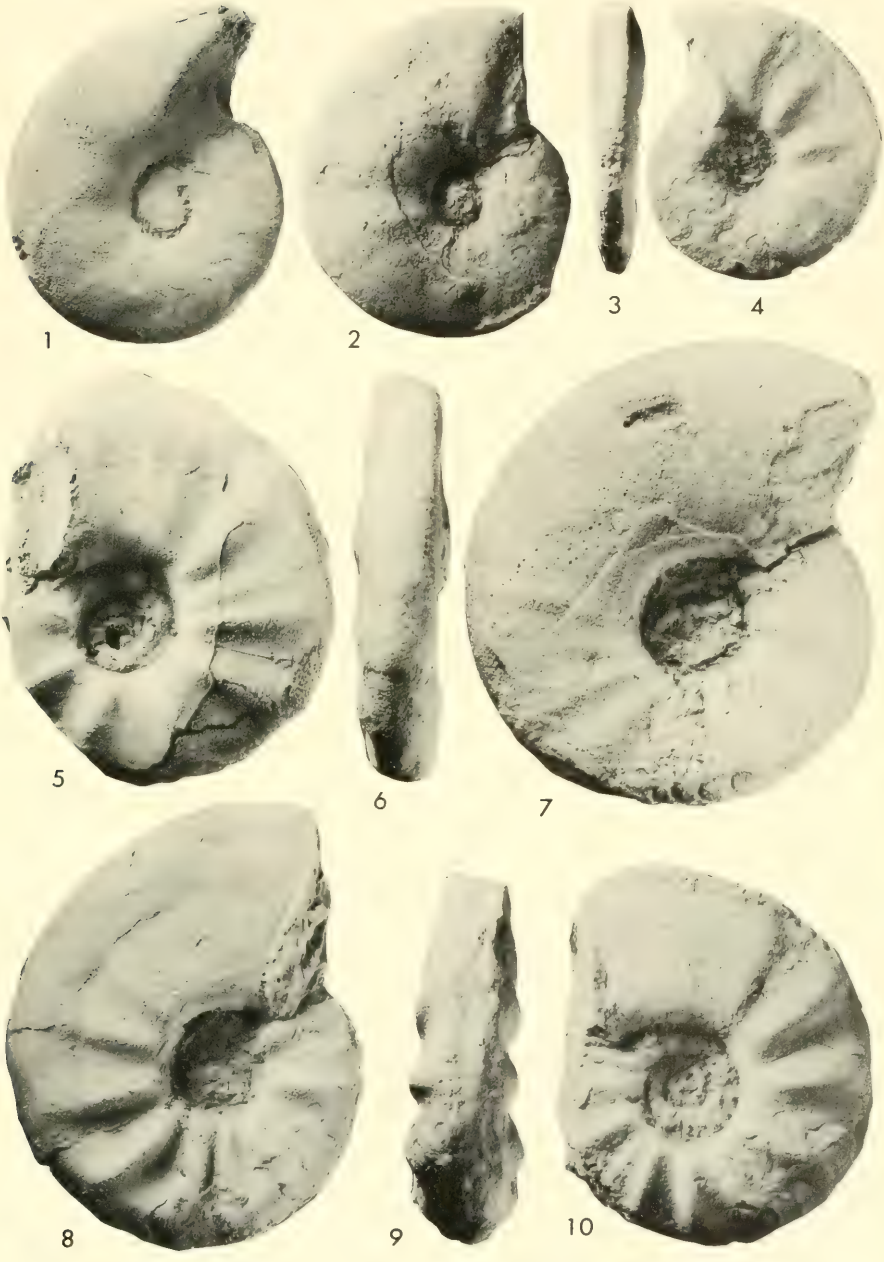

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PLATE 59. DINARITES DALMATINUS

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1–11 *Dinarites dalmatinus* (Hauer) 506

Figs. 1, 2, plesiotype, *Dinarites laevis* Tommasi,–Kittl (1903: pl. 1, fig. 1), × 1. Figs. 3, 4, plesiotype, *Dinarites laevis* Tommasi,–Kittl (1903: pl. 1, figs. 2, 3), × 1. Figs. 5, 6, plesiotype, *Dinarites muchianus* (Hauer),–Kittl (1903: pl. 1, fig. 7), × 1. Figs. 7, 8, plesiotype, *Dinarites muchianus* (Hauer),–Kittl (1903: pl. 1, fig. 5), × 1. Figs. 9, 10, syntype, *Dinarites evolutior* Kittl (1903: pl. 1, fig. 10), × 1. Fig. 11, syntype, *Dinarites evolutior* Kittl (1903: pl. 1, fig. 9), × 1.

All specimens are from the Werfen Formation at Muć, Dalmatia, and are deposited in the Natural History Museum, Vienna.

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PLATE 60. DINARITES DALMATINUS

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1–8 *Dinarites dalmatinus* (Hauer) 506

Fig. 1, plesiotype, var. *plurimcostatus* Kittl (1903: pl. 2, fig. 10), × 1. Fig. 2, plesiotype, var. *externeplanatus* Kittl (1903: pl. 3, fig. 1), × 1. Fig. 3, plesiotype, var. *externeplanatus* Kittl (1903: pl. 3, fig. 2), × 1. Fig. 4, plesiotype, var. *extensus* (Kittl: 1903, pl. 2, fig. 8), × 1. Fig. 5, holotype *Dinarites multicostatus* Kittl (1903: pl. 3, fig. 3), × 1. Fig. 6, syntype, *Dinarites tirolitoides* Kittl (1903: pl. 7, fig. 3), × 1. Fig. 7, syntype, *Dinarites tirolitoides* Kittl (1903: pl. 7, fig. 2), × 1. Fig. 8, plesiotype,–Kittl (1903: pl. 2, fig. 7), × 1.
All specimens are from the Werfen Formation at Muć, Dalmatia, and are deposited in the Natural History Museum, Vienna.

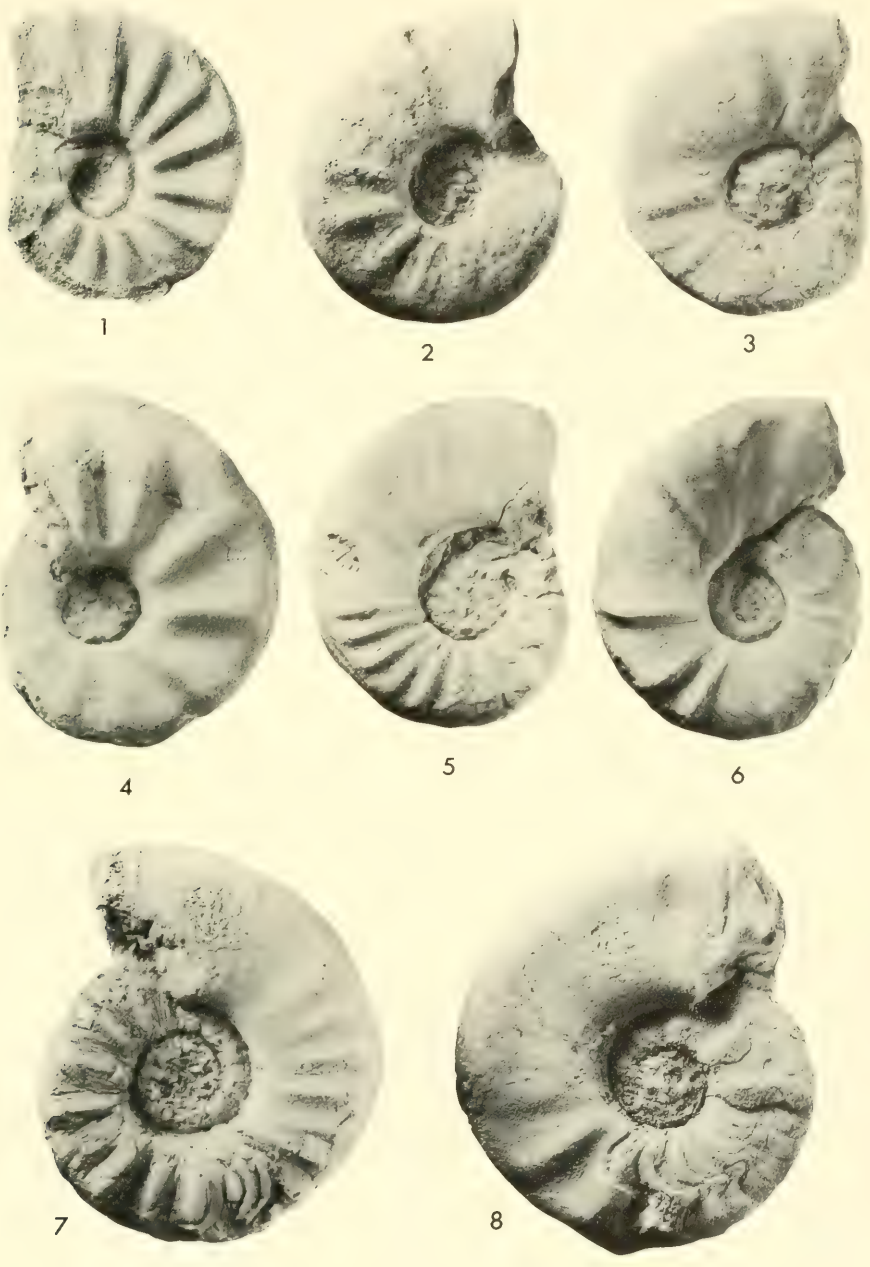

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PLATE 61. DINARITES CARNIOLICUS

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1–8 *Dinarites carniolicus* (Mojsisovics) 510

Figs. 1, 2, plesiotype –Kittl (1903: pl. 5, fig. 1), × 1. Fig. 3, plesiotype,–Kittl (1903: pl. 5, fig. 2), × 1. Fig. 4, plesiotype,–Kittl (1903: pl. 5, fig. 3), × 1. Fig. 5, plesiotype,–Kittl (1903: pl. 5, fig. 4), × 1. Figs. 6, 7, syntype, *Tirolites serratelobatus* Kittl (1903: pl. 5, fig. 4), × 1. Fig. 8, syntype, *Tirolites serratelobatus* Kittl (1903: pl. 5, fig. 6), × 1.

All specimens are from the Werfen Formation at Muć, Dalmatia, and are deposited in the Natural History Museum, Vienna.

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PLATE 62. DIAPLOCOCERAS, PSEUDOKYMATITES, and PSEUDODINARITES

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1–4	*Diaplococeras connectens* (Mojsisovics) Fig. 1, holotype, *Dinarites (Hercegovites) diocletiani* Kittl (1903: pl. 3, fig. 4), × 1. Fig. 2, lectotype, *Dinarites (Liccaites) progressus* Kittl (1903: pl. 4, fig. 2), × 1. Figs. 3, 4, lectotype, *Dinarites biangulatus* Kittl (1903: pl. 4, fig. 1), × 1.	504
5	*Pseudokymatites svilajanus* (Kittl) Holotype (Kittl, 1903: pl. 4, fig. 3), × 1.	475
6	*Pseudodinarites mohamedanus* (Mojsisovics) Plesiotype,–Kittl (1903: pl. 3, fig. 5), × 0.6.	511

All specimens are from the Werfen Formation at Muć, Dalmatia, and are deposited in the Natural History Museum, Vienna.

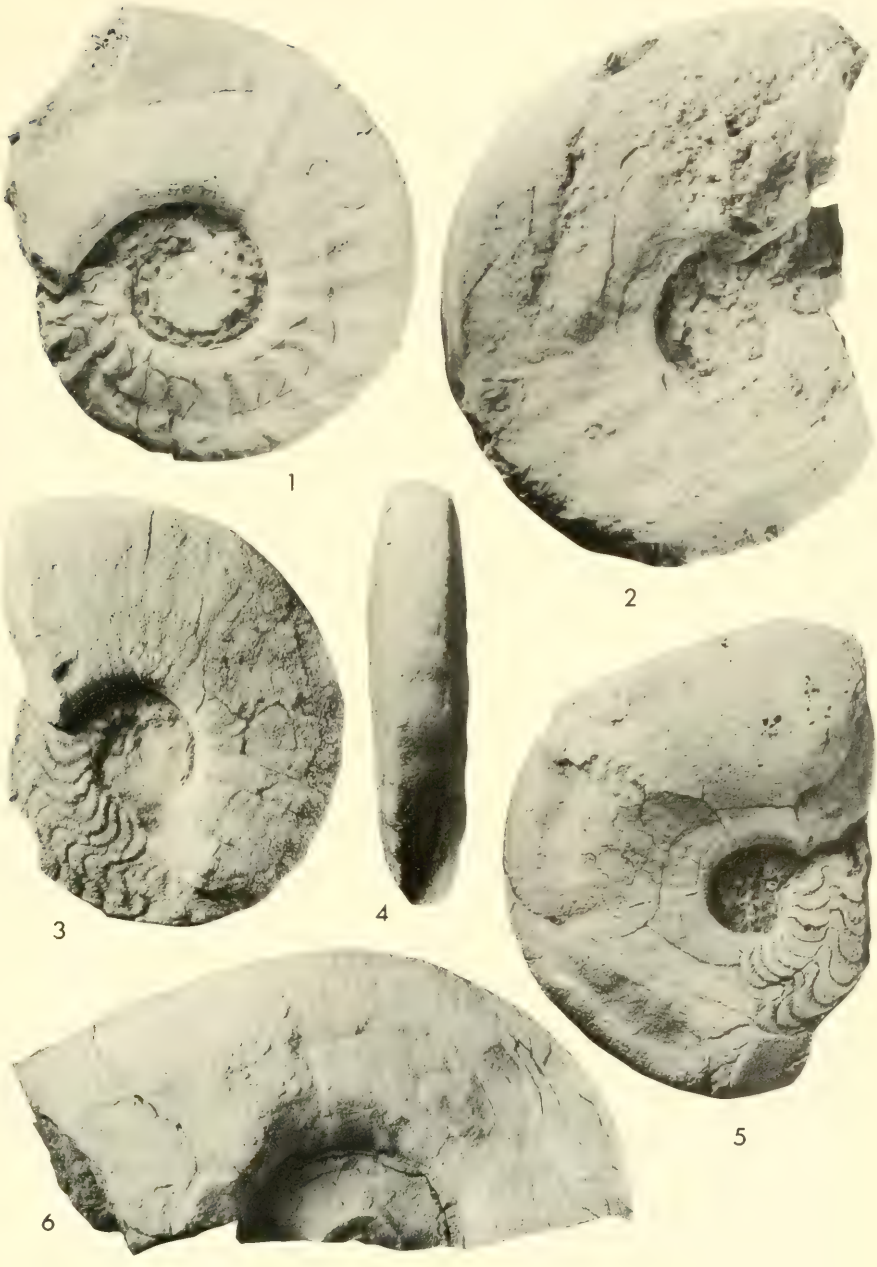

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PLATE 63. TIROLITES CASSIANUS

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1–9 *Tirolites cassianus* (Quenstedt) 493

Fig. 1, plesiotype, *Tirolites darwini*,–Kittl (1903: pl. 11, fig. 1), × 1. Figs. 2, 3, plesiotype, *Tirolites darwini*,–Kittl (1903: pl. 10, fig. 5), × 1. Fig. 4, lectotype, *Tirolites multispinatus* Kittl (1903: pl. 11, fig. 9), × 1. Figs. 5, 6, lectotype, *Tirolites percostatus* Kittl (1903: pl. 10, fig. 6), × 1. Fig. 7, plesiotype, *Tirolites turgidus*,–Kittl (1903: pl. 10, fig. 7), × 1. Fig. 8, plesiotype, *Tirolites darwini*,–Kittl (1903: pl. 11, fig. 3), × 1. Fig. 9, plesiotype, *Tirolites smiriagini*,–Kittl (1903: pl. 11, fig. 6), × 1.

All specimens are from the Werfen Formation at Muć, Dalmatia, and are deposited in the Natural History Museum, Vienna.

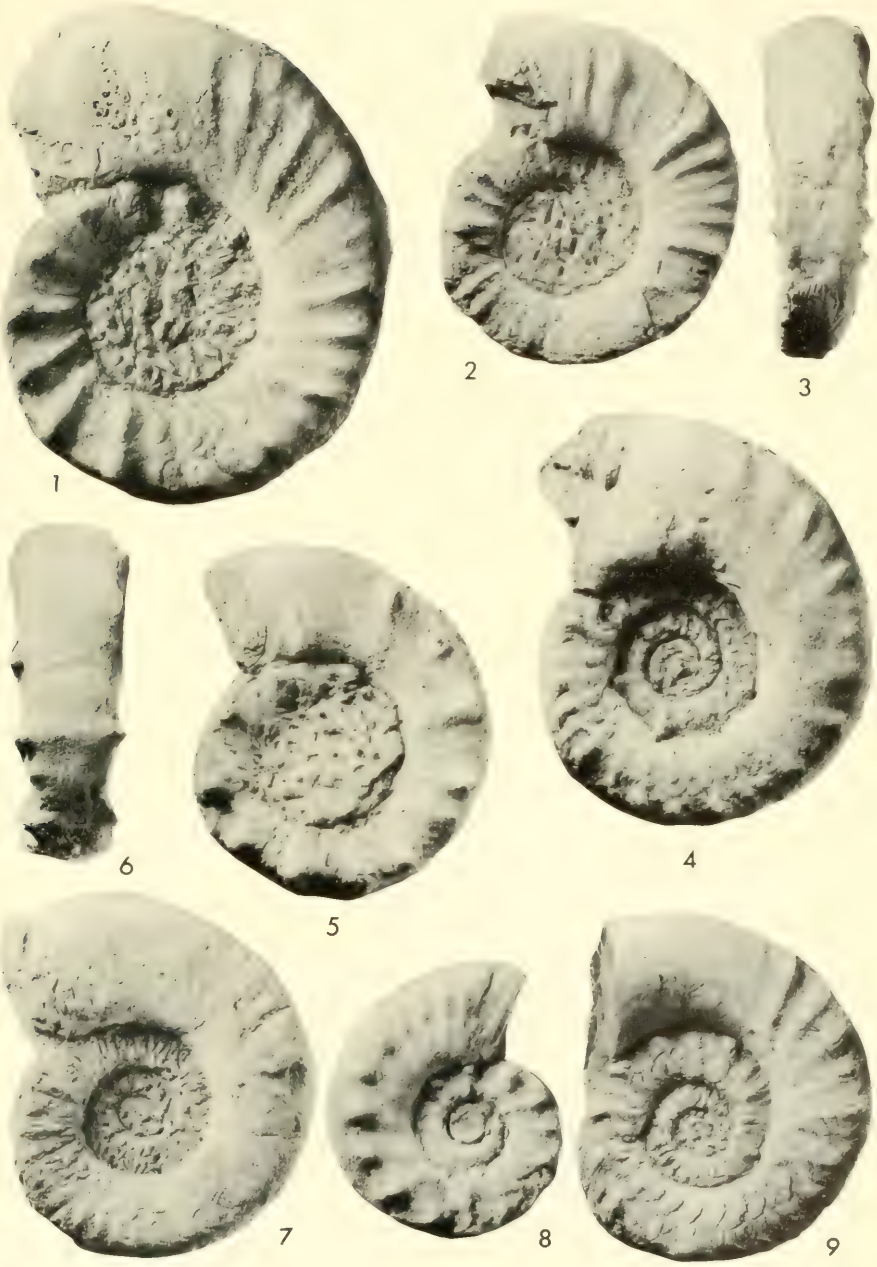

Plate 63

PLATE 64. TIROLITES CASSIANUS

Figures

1–4 *Tirolites cassianus* (Quenstedt)

Figs. 1, 2, lectotype, *Tirolites spinosior* Kittl (1903: pl. 11, fig. 5), × 1. Fig. 3, syntype, *Tirolites toulai* Kittl (1903: pl. 11, fig. 11), × 1. Fig. 4, plesiotype, *Tirolites darwini*,–Kittl (1903: pl. 10, fig. 11), × 1. All specimens are from the Werfen Formation at Muć, Dalmatia, and are deposited in the Natural History Museum, Vienna.

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PLATE 65. TIROLITES CASSIANUS

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1–9 *Tirolites cassianus* (Quenstedt) 493

Fig. 1, figured specimen, *Tirolites angustilobatus* var. *alpha* Kittl (1903: pl. 8, fig. 19), × 1. Fig. 2, lectotype, *Tirolites angustilobatus* Kittl (1903: pl. 9, fig. 3), × 1. Fig. 3, plesiotype,–Kittl (1903: pl. 9, fig. 5), × 1. Fig. 4, figured specimen, *Tirolites angustilobatus* var. *alpha* Kittl (1903: pl. 9, fig. 1), × 1. Fig. 5, plesiotype,–Kittl (1903: pl. 9, fig. 4), × 1. Fig. 6, plesiotype,–Kittl (1903: pl. 9, fig. 6), × 1. Figs. 7, 8, plesiotype, *Tirolites spinosus*,–Kittl (1903: pl. 9, fig. 7), × 1. Fig. 9, plesiotype *Tirolites haueri*,–Kittl (1903: pl. 9, fig. 10), × 1.

All specimens are from the Werfen Formation at Muć, Dalmatia, and are deposited in the Natural History Museum, Vienna.

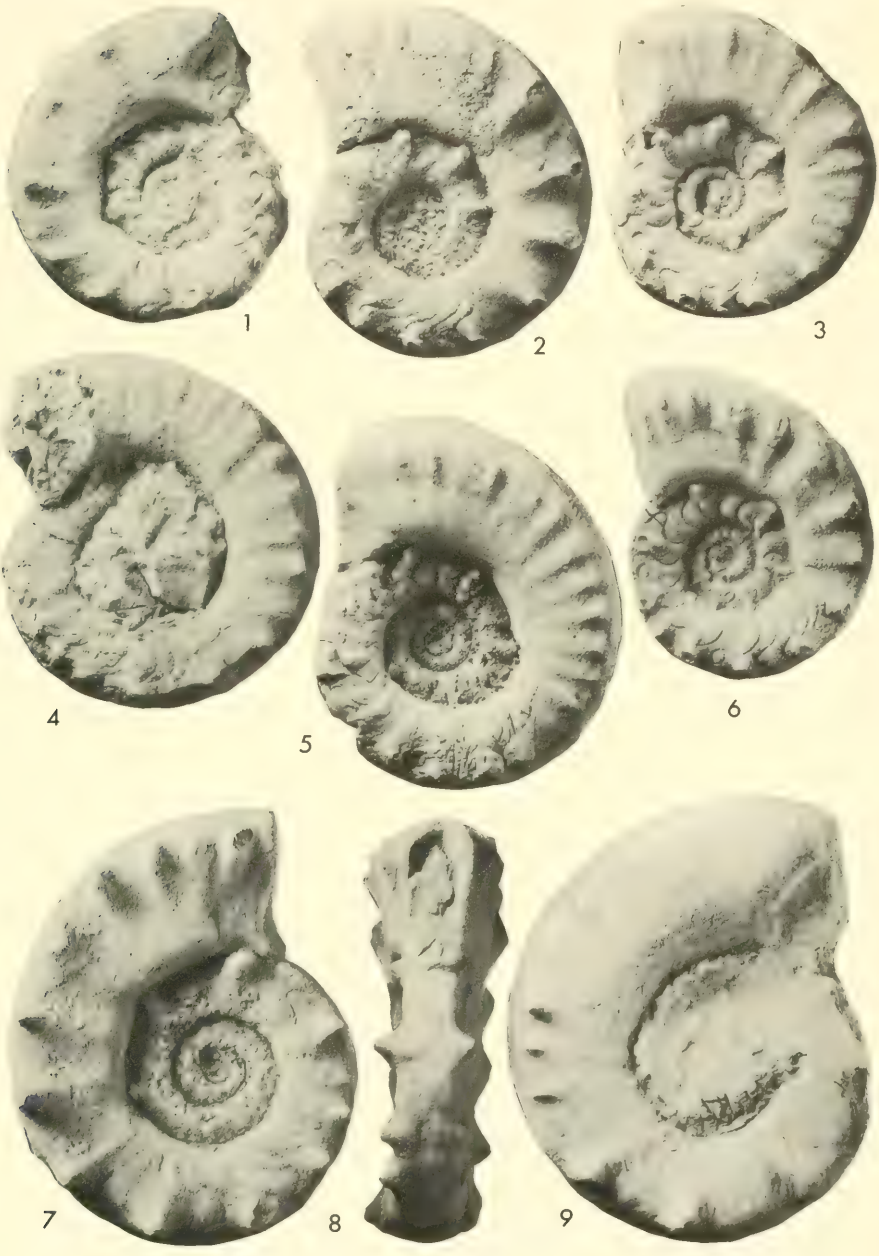

Plate 65

PLATE 66. TIROLITES IDRIANUS

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1–13 *Tirolites idrianus* (Hauer) 492

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All specimens are from the Werfen Formation at Muć, Dalmatia, and are deposited in the Natural History Museum, Vienna.

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All specimens are from the Werfen Formation at Muć, Dalmatia, and are deposited in the Natural History Museum, Vienna.

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All specimens are from the Werfen Formation at Muć, Dalmatia, and are deposited in the Natural History Museum, Vienna.

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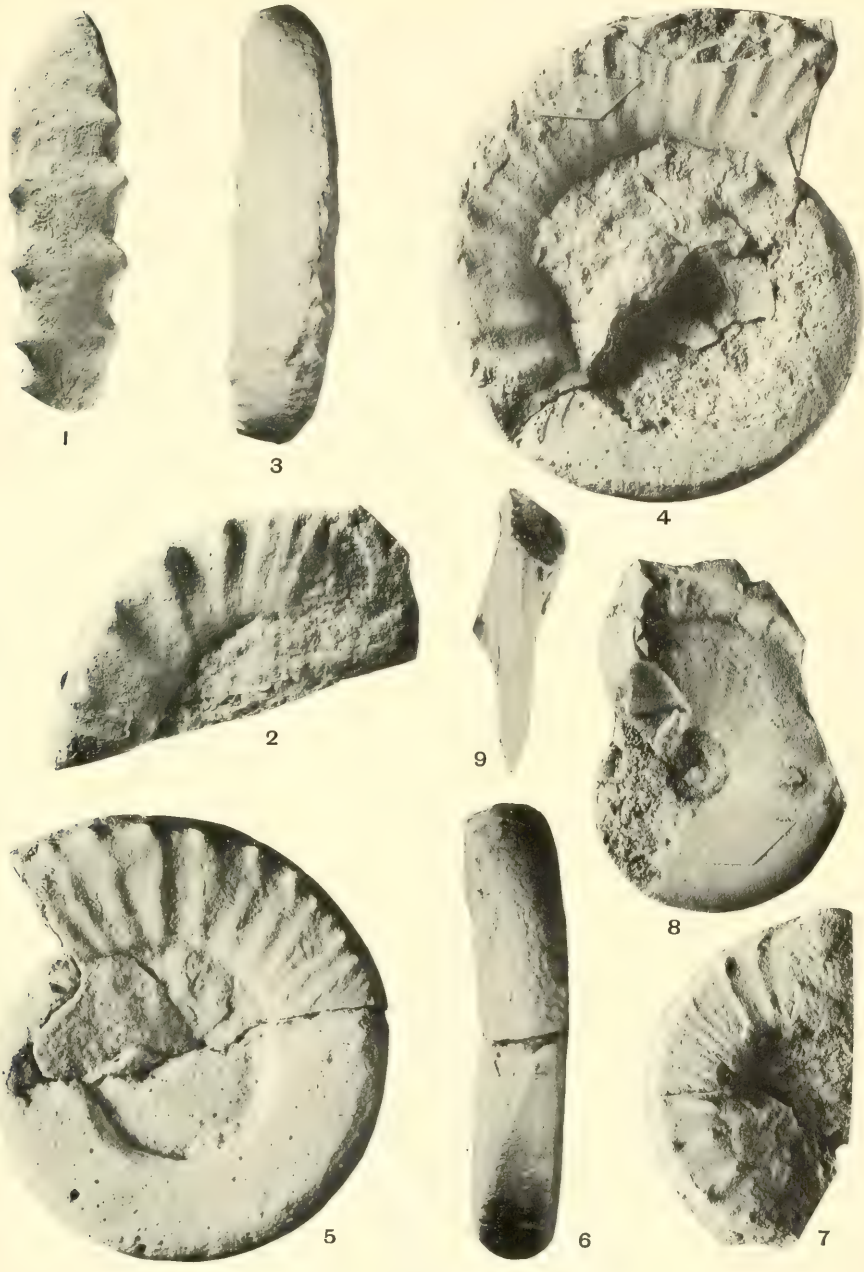
All specimens are from the *Tirolites* Zone, Thaynes Formation, Paris Canyon, Bear River Range, southeast Idaho.



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